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BUSINESS - INDUSTRY - SCIENCE

PEANUT OIL

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PEANUT OIL is one of the most important of the world's food oils.

High-grade peanut oil is an excellent salad oil. The various grades of this oil are used for making oleomargarine and soap and for industrial purposes.

Within the last few years the manufacture of peanut oil has attained considerable importance in the United States. Large quantities are imported, for the most part from China, Japan, and Europe.

Peanut oil can be made in cottonseed-oil plants without many changes in the equipment.

High-grade peanut oil can be made only from sound, well-selected stock, and the manufacturing methods must be of the best.

Peanut meal, the leading by-product of peanut-oil manufacture, is a valuable material, rich in protein and oil. The better grades may be used for human food and the poorer grades for stock feeds.

Peanut oil and peanut meal should be correctly labeled and advertised for just what they are.

PEANUT OIL.[1]

CONTENTS.

	Page.		Page.
Importance of the industry	3	By-products of peanut-oil manufacture	14
The manufacture of peanut oil in Europe	4	Economic considerations in connection with the manufacture of peanut oil	15
Varieties of peanuts grown in the United States	6	Yield of peanuts, cost of production, and returns	15
Preparing peanuts for oil making	8	The proper labeling of peanut products	16
Machinery for extracting peanut oil	9	Summary	17
Analyses of American-grown peanuts	9		
The manufacture of peanut oil in the United States	12		

IMPORTANCE OF THE INDUSTRY.

THE manufacture of peanut oil is a well-established industry in most parts of the South wherever peanuts are grown to any considerable extent. Previous to the year 1915 a comparatively small quantity of commercial peanut oil was made in this country, but since that time its manufacture has been increasing rapidly. This has been due to the appreciation of the peanut as a source of vegetable oil and to the desire to find an outlet for at least a portion of the peanut crop.

The peanut is rapidly assuming a position of very great importance in southern agriculture, owing to its suitability as a substitute crop for cotton in sections infested by the boll weevil. It has been found that peanuts can be crushed for oil and that the product after the oil is removed is more valuable, pound for pound, as a stock feed than it was before the oil was removed.

Peanut oil is one of the most important of the world's food oils. In the years immediately preceding the World War almost 40,000,000 gallons of peanut oil were produced annually in Marseille, France. This industry was interrupted by the war. In 1917 about 3,000,000 gallons of peanut oil were imported into this country, a large proportion of this coming from China. In the first 10 months of 1919 nearly 20,000,000 gallons of peanut oil were imported into this country, mainly from Japan and China. This quantity is much larger than that imported during any previous year; and as in all probability its importation was due to abnormal conditions brought about by the close of the war, these figures should not be taken as an indication of what may be expected in future.

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[1] This bulletin has been revised by J. H. Beattie and F. E. Miller, of the Office of Horticultural and Pomological Investigations, Bureau of Plant Industry.

Peanut oil is used for a variety of purposes, chiefly as a salad oil, and its use is rapidly increasing, as it has proved to be highly desirable for this use and also in the making of oleomargarines and soaps.

THE MANUFACTURE OF PEANUT OIL IN EUROPE.

At least 10 geographically distinct varieties of peanuts are quoted on the Marseille market. Those from the French colonies of West Africa (Gambia, Rufisque, Kasamanze, Rio Nuez, and Bissagos) are usually imported in the shells, while the shelled nuts come from China, Mozambique, Bombay, and the Coromandel Coast of India. Peanuts in the shell from Rufisque, Soloum, Sina, and Gambia contain from 35 to 36 per cent of oil and yield on a large scale from 28 to 30 per cent of shells and 31½ to 32½ per cent of oil. Figured on the basis of shelled nuts, the oil yield is 44 to 45 per cent. The cake usually retains from 8 to 9 per cent of oil. Kasamanze nuts yield 30½ to 31½ per cent of oil. The decorticated Bombay and Coromandel nuts yield 36 to 38 per cent, while those from Mozambique on a practical scale yield 40 to 42 per cent.

The best grades of oil, of course, are made from stock shipped in the shells, as with these there is less opportunity for spoilage during the ocean voyage than with the shelled nuts. The Chinese nuts, which are shelled almost entirely by hand and carefully protected from water or crushing, give a better grade of oil than that obtained from some of the unshelled nuts. Peanuts from India, especially those from the Coromandel Coast, are at present largely shelled by the native method of wetting them down with water so that they open of their own accord when they are flayed out with clubs. These nuts are not allowed to dry thoroughly before being shipped and consequently undergo heating in transit to Europe, so that as a rule they can not be used for the production of good edible oils, but are worked up for soap stock. The Coromandel nuts are practically all used in this way.

Abroad, almost invariably peanut oil is made from shelled nuts. Mills that buy the nuts in the shells must first shell them by machinery designed particularly for that purpose. The foreign matter, such as sticks and stones, and a small quantity of unshelled peanuts are next removed by running the shelled stock over screens similar to the shakers used in the cotton-oil mills. Then the inner or red skins are removed as completely as possible. These skins, which, strange to say, contain about 14 per cent of oil, are usually saved, added to the refuse meat, and expressed with it, yielding a small quantity of inferior oil. When thoroughly cleaned, the kernels are ground, usually by a system of corrugated rolls which do not crush them as fine as cottonseed is ground in this country.

The ground material is then pressed in what is known as the Marseille press. This is somewhat similar to the ordinary fruit or cider press used in this country, but more powerful. It consists of a piston carrying a platform upon which the square cheeses (meal wrapped in press cloth) are laid, one at a time, each successive cake being separated from the one below it by a thin steel plate. These presses have no protecting sides, or "boxes," such as are usually found in the American hydraulic presses, and the pressure which is applied to the peanuts is much less than that used with cottonseed. When the press is full, the pressure is applied and the material allowed to stand under pressure until a little over half of the oil has been squeezed out. This gives what is known as cold-drawn oil, which is nearly colorless, has a pleasant, nutty taste, and needs no refining to make it suitable for salad or cooking uses, provided, of course, the original peanut material was clean and free from rancid nuts.

After the first pressing the cakes are taken out of the cloths, reground, and sometimes a small quantity of moisture is added. After being heated for a few minutes new cakes are formed and again pressed. The oil thus obtained is of a quality inferior to that from the first pressing and goes into a low-grade edible oil or prime soap oil. A third pressing usually is made, and in some mills a fourth, before the cake has been exhausted. Both of these pressings are made after regrinding and heating the cake. About 6 per cent of oil is usually left in the final cake, which according to Bolton and Revis[1] has the following average composition:

	Per cent.		Per cent.
Moisture	10. 68	Albuminoids	45. 12
Oil	5. 8	Digestible carbohydrates	30. 49
Woody fiber	3. 85	Mineral matter	4. 06

For edible uses the European market requires a very light colored oil, and to obtain this it is usually necessary to filter it through fuller's earth or charcoal. If the oil is to be used in making margarine this removal of color is not only unnecessary but undesirable.

Within the last few years rapid progress has been made abroad, especially in Marseille and Nice, in the refining and deodorizing of vegetable oils. According to Thompson,[2] in 1912 some 175,000 barrels of Coromandel peanut oil, which would formerly have been considered inedible, was, by refining, put into the edible class. As this oil often runs as high as 25 to 40 per cent of free fatty acid, the refining loss is very high.

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[1] Bolton, E. R., and Revis, Cecil. Fatty Foods, Their Practical Examination, p. 204. London [n. d.].

[2] Thompson, E. W. Edible oils in the Mediterranean district. U. S. Dept. Com., Bur. For. and Dom. Com., Spec. Agent Ser. No. 75, p. 8. 1913.

In Europe the very finest grades of peanut oil are used exclusively for edible purposes, and practically all that is produced in France is consumed at home, only second-grade oils being exported to the United States. Probably a large portion of the second-grade edible oil made in France, Germany, and Holland is used by these countries in the manufacture of vegetable margarines, which are mixtures of peanut, coconut, and similar oils ripened with milk. An additional quantity of peanut oil enters into the composition of oleomargarine; that is, margarines which contain animal fats. Since olive oil will not stand the high or continued heating required of oils used in the cooking of such products as sardines, peanut oil is generally used. After the fish have been cooked in the peanut oil they are drained, put into cans, and the cans filled with olive oil. In addition to these three uses for edible peanut oil large quantities of the low-grade or inedible oils go into the soap kettles of Europe.

VARIETIES OF PEANUTS GROWN IN THE UNITED STATES.

Nine distinct varieties of peanuts are grown in the United States—Spanish, Improved Spanish, Valencia, Tennessee Red, Tennessee White, Virginia Bunch, Virginia Runner, Jumbo, and African (also called North Carolina Runner). While any of these can be used in the manufacture of peanut oil, the Spanish is the best one and is the only variety that should be grown for this purpose. The Spanish peanut is adapted to a wider range of soil and climatic conditions and has a higher oil content than any other variety, with the possible exception of the Valencia.

The following descriptions of varieties may be of interest to those not familiar with them:

Spanish.—A small-podded variety with heavy foliage; stems upright; pods thin, usually well filled, clustered about the base of the plant and adhering well in digging; peas rich in oil. This variety will mature in less time than any other and can be planted after a crop of early vegetables or after oats, wheat, or some other grain crop. The standard weight is 30 pounds per bushel.

Improved Spanish.—This variety has been developed from the Spanish, which it resembles except that the stems are coarser, longer, and the plant less upright in habit of growth. It differs markedly from the ordinary Spanish in that the pods are about twice as large. This variety weighs the same per bushel as the ordinary Spanish.

Virginia Bunch.—A large-podded variety with rather light foliage; stems upright; pods clustered about the base of the plant. The customary weight per bushel is 22 pounds. As this variety has a lower oil content and a smaller proportion of meats to shell than the Spanish, it should not be grown for oil purposes.

Virginia Runner.—A large-podded variety with heavy foliage; stems creeping; pods scattered along procumbent stems and not adhering well in digging; pods and peas similar to those of the Virginia Bunch peanut. This variety is harder to cure than the bunch types, because the pods are scattered along the stems and can not be as well protected from the weather as the varieties with nuts clustered near the base of the plant. The weight per bushel is 22 pounds.

Jumbo.—This variety is similar to the Virginia Runner, except that the pods are much larger. The Jumbo is grown to a limited extent in southeastern Virginia and northeastern North Carolina. It is used mostly for roasted peanuts sold in the shell and for confectionery. The weight per bushel is 22 pounds.

Valencia.—A small-podded variety with heavy foliage; stems upright; pods long, usually containing three or four peas, but sometimes as many as five or six; peas dull red, darker in color than the Spanish. This variety is a rather heavy yielder, but the pods pull off badly in digging. It is not grown to any great extent in this country.

African (or North Carolina Runner).—A small-podded variety with very heavy dark-green foliage; stems creeping, sometimes having a spread of 3 or 4 feet; pods scattered along procumbent stems and not adhering well in digging; small, a little larger than the Spanish variety, usually containing two peas. As the African peanut produces a larger percentage of "pops," or poorly filled pods, than any other variety and requires a longer growing season, it should not be generally grown.

Tennessee Red.—This variety is closely related to the Valencia and is grown in a few sections of the South, mainly for home use and for hog feeding. The vine growth is very similar to that of the Valencia, but the yield is not so heavy and the pods pull off badly in digging. The pods are long and angular, containing from one to five kernels of a dark-red color. They are rough and much more constricted than the Valencia. The customary weight per bushel is 30 pounds.

Tennessee White.—This variety is the same as the Tennessee Red except that the kernels have a light pinkish color.

The Spanish peanut contains a larger proportion of meats to hulls than any other variety. In a shelling test made by the United States Department of Agriculture, farmers' stock Spanish peanuts shelled out 78.70 per cent, the Virginia Bunch 71.15, and the African 71.45 per cent. In this test the trash and dirt usually found in farmers' stock peanuts were not considered. Clean peanuts were selected from an average sample as they are received at cleaning and shelling plants. They were shelled by hand and the meats and hulls were weighed separately. In a commercial shelling plant the percentage of meats secured would probably be at least 10 per cent less than was found in this test because of the dirt, trash, and "pops," or poorly filled pods; in fact, cleaners are satisfied if they secure 66 to 70 per cent of meats from farmers' stock Spanish peanuts and about 60 per cent for the Virginia type. Shelled Spanish peanuts contain 5 to 10 per cent more oil than the Virginia Bunch and Virginia Runner varieties. The oil content, taken in connection with the difference in the weight per bushel, the habit of growth, quicker maturity, etc., shows that the Spanish is much more valuable for oil production than any other variety of peanut grown in the United States.

In addition to peanuts grown especially for oil, large quantities of low-grade nuts which accumulate at cleaning and shelling plants are used in the making of low-grade oil for soap or other industrial purposes. This practice is a distinct advantage to the industry when the product is not sold for purposes to which it is not adapted. Much harm has been done in the past, however, through the efforts of manufacturers to bring about the use of low-grade, poorly made peanut oils for table purposes. High-grade oil can not be made from low-grade stock, and the making of first-class peanut oil necessitates the use of the best raw material and the most careful methods of manufacture. The sooner all manufacturers realize that the making of good peanut oil necessitates attention to these points the better it will be for the industry.

PREPARING PEANUTS FOR OIL MAKING.

Where the very highest grade edible oil is desired, it may be necessary thoroughly to clean, shell, blanch, and degerm the peanuts. Peanuts as received from the farmers usually contain considerable dirt, sticks, and trash of various kinds. These materials must be removed by screens, fans, or suction blasts, such as are used in cleaning and shelling establishments, whether the nuts are to be pressed before or after shelling. Peanuts are usually shelled by machines made especially for this purpose. It is possible that the cottonseed huller can be used for shelling peanuts, but the machine would have to be so adjusted as to give greater clearance space for the peas, to prevent breaking them, and run at a slower speed than for cottonseed. After the nuts are shelled, the peas are separated from the hulls by means of a fan or suction blast. In the regular shellers the hulls and chaff are separated from the meats by suction as they fall from the sheller. This separation could be made in the same manner as they fall from the cottonseed huller.

In order to get the peanut kernels entirely free from trash and bad nuts, it is necessary to hand pick them. In the cleaning and shelling plants this is done by passing them over a "picking table," alongside of which are seated a number of women, who pick out foreign matter and decayed nuts as the peanuts pass on a slowly moving belt. The hand picking would not be necessary except for a high-grade oil.

The blanching process consists in removing the red skin. The same operation usually separates the pea or kernel into halves and removes the germ or heart. Blanching is accomplished by means of blanching machines, consisting of a set of brushes revolving against a corrugated plate. The meats are separated from the chaff and germs by passing them over screens and in front of a fan. The skins are blown out and the germs fall through the screen, which should have round holes seven thirty-seconds of an inch in diameter. It is not feasible to remove all of the red skin, but as much as possible should be removed. The germs should also be removed, as the oil in them is of a lower quality than that in the remainder of the nut.

When using a hydraulic press for expressing peanut oil it is necessary to grind the peanuts and run the ground material through rolls to crush the oil cells. The grinding and rolling, or crushing, can be accomplished by using the grinders and rolls now used in cotton-oil mills.

When using a continuous-working machine of the expeller type it is not necessary to grind the material, although the cake would have to be ground for the second pressing.

As the germs are quite rich in oil and the skins contain about 14 per cent, these products should not be wasted. They can be used advantageously in the manufacture of low-grade oils, which can later be refined in a manner similar to crude cottonseed oil or used in making soap. Some of the manufacturers of peanut butter and other peanut products are now selling to oil mills for a good price the germs and seed coats, or skins, which are waste in their plants.

MACHINERY FOR EXTRACTING PEANUT OIL.

In the manufacture of peanut oil in a cottonseed-oil mill it would be necessary to install additional machinery in order to make a high-grade oil. The oil presses, grinders, filter presses, and conveyors in use in cotton-oil mills can be used for making peanut oil. In addition to these machines, it would be advisable to install equipment that is used in peanut cleaning and shelling factories. This equipment consists of cleaning, shelling, and blanching machines and the necessary conveyors, fans, sieves, etc. Dealers in peanut cleaning and shelling machinery can probably furnish all the equipment necessary in preparing peanuts for oil making.

It is probable that machinery made in this country for use in peanut cleaning and shelling plants would be more satisfactory than that used in Marseille. The peanut industry is much more highly developed in the United States than anywhere else in the world, and practically all the machinery used has been designed especially for this purpose.

ANALYSES OF AMERICAN-GROWN PEANUTS.

Unfortunately, the number of analyses of American-grown peanuts is small, but those given in the Tables I and II are fairly representative. More analyses have been made of the Spanish and Virginia than of any other varieties, because they are the most important commercial types. Table I presents analyses of 12 samples of Spanish and 19 samples of Virginia peanuts.

TABLE I.—*Analyses of peanuts of the Spanish and Virginia varieties grown in the United States.*

Variety.	Source.	Constituents (per cent).			
		Moisture.	Oil.	Oil (dry basis).	Ash.
Spanish:					
Sample a		3.8	50.2	52.2	
Sample b		5.1	50.6	53.3	2.3
Sample c		2.7	52.8	54.3	2.4
Sample d		4.2	47.6	49.7	2.4
Sample e		2.6	49.4	50.7	2.4
Sample f		6.4	48.0	51.0	2.4
Sample g	Mississippi	3.2	50.1	51.8	
Sample h	North Carolina	3.3	48.2	49.8	
Sample i	District of Columbia	3.4	52.2	54.0	
Sample j		6.3	49.0	52.3	
Sample k		1.4	50.4	51.1	
Sample l	Louisiana	4.4	47.4	49.6	
Average		3.9	50.0	52.5	2.4
Virginia:					
Grade No. 1		3.5	43.0	44.5	
Grade No. 3		3.5	45.3	47.0	
Grade No. 1		5.4	41.1	43.5	
Grade No. 2		6.2	38.1	40.6	
Grade splits		3.4	46.4	48.0	
Grade No. 1		5.1	40.1	42.3	2.0
Do		.5	48.3	48.5	2.0
Do		.6	47.2	47.4	2.1
Grade No. 2		6.3	44.3	46.6	2.3
Do		2.5	45.1	46.2	2.1
Do		1.7	45.2	45.9	2.7
Grade No. 3		7.1	43.8	44.2	3.9
Do		4.0	35.9	37.4	4.4
Do		3.5	35.2	36.5	3.2
Do		6.3	29.8	31.6	
Do		4.7	36.5	38.3	
Farmers' stock		4.1	37.2	38.8	
Do		3.6	45.7	47.4	
Do		4.7	40.0	42.0	
Average		4.1	41.7	43.3	2.7

It will be noticed that the average percentage of oil for the 12 samples of Spanish peanuts is 52.5 and of the 19 samples of the Virginia variety, 43.3, figured on the basis of dry shelled nuts.

As has already been stated, the weight of shells and trash per ton of farmers' stock is about 600 pounds, so that the average amount of oil in a ton of unshelled Spanish peanuts, figured on the basis of 50 per cent of oil, is approximately 700 pounds. Similarly, for Virginia peanuts, which have an average oil content of 42 per cent in the shelled goods and run about 800 pounds of shells and trash to the ton of farmers' stock, there are 500 pounds of oil per ton. The amount of oil present in the average sample of farmers' stock peanuts as received at the mill will usually be slightly less than this, owing to the higher moisture content in the raw material.

Assuming that the residual cake will contain 9 per cent of oil, the theoretical yield would be 630 pounds of oil per ton of farmers' stock of Spanish and 430 pounds of oil per ton of Virginia peanuts. The laboratory experiments carried on over a series of years by the United States Department of Agriculture, in which peanuts from various sections of the country were pressed in a half-size expeller, indicate that under ideal conditions it is possible to obtain in a single pressing a cake which has as low as 6 per cent of oil, and in one or two instances it has been possible to obtain by a second pressing cakes containing less than 5 per cent. These results apply to both peanuts pressed in the shell and shelled goods. On a larger scale, however, it will probably be impracticable and doubtless undesirable to work for such high yields. The tonnage capacity of the continuous press decreases rapidly when attempts are made to obtain a cake with less than 8 or 9 per cent, and the increased labor and power cost would thus more than offset the increased value of the oil recovered. Laboratory experiments with the continuous press or expeller could not be paralleled with similar runs on a hydraulic press, and the only data available are those obtained from analyses of a few isolated samples of cake. These were obtained from cotton-oil mills, where the peanuts were pressed in their regular hydraulic presses. The oil content of these cakes varies between 7 and 9 per cent.

Analyses of the shelled nuts and of the shells of the five standard varieties of peanuts grown on the same soil at Florence, S. C., in 1915 are given in Table II. These peanuts were grown and analyzed by the department. So far as the writers have been able to learn, these analyses are the only ones ever made of the five types of peanuts grown under identical conditions.

TABLE II.—*Analyses of five varieties of peanuts grown at Florence, S. C.*

Variety.	Constituents of shelled nuts (per cent).					Constituents of shells (per cent).				
	Moisture.	Oil.	Crude fiber.	Protein.	Ash.	Moisture.	Oil.	Crude fiber.	Protein.	Ash.
Virginia Runner	3.35	46.58	2.73	29.60	2.76	5.23	0.73	78.28	5.07	4.11
Virginia Bunch	3.28	45.73	2.84	29.52	3.11	5.23	3.53	70.00	7.25	3.95
Spanish	3.30	49.10	2.30	31.20	2.67	5.03	3.20	66.70	8.16	6.81
Valencia	3.75	49.60	2.13	33.64	2.67	5.80	1.38	70.72	7.23	3.34
African	3 45	45.90	2.26	30.30	3.31	5.45	2.46	71.70	7.60	3.38

It will be noticed that there is very little difference between the oil content of the Valencia and the Spanish and that these two varieties are higher in oil than the other three. The Virginia Bunch, Virginia Runner, and African have nearly the same percentage of oil. The difference in oil content of the five varieties is not very great. In fact, there is as much difference in the percentage of oil in Spanish peanuts grown under different conditions as there is between the different varieties grown under the same conditions, as can be seen by comparing Tables I and II.

It will be noticed that the shells from Spanish peanuts contain less crude fiber and more protein and ash than any other variety. The shells of the Virginia Runner peanuts contain less oil and protein and more crude fiber than any other variety.

THE MANUFACTURE OF PEANUT OIL IN THE UNITED STATES.

Since 1915 the manufacture of peanut oil in the United States has been an important commercial industry. The quantity of peanuts crushed for oil varies from year to year, owing to the market demands for the nuts for other purposes. Naturally peanuts are crushed only when the oil can be produced and sold in competition with cottonseed oil. At present (1920) very little peanut oil is being made in the United States, owing to the scarcity and high price of peanuts. However, this condition is in all probability only temporary. Practically all the cottonseed-oil mills throughout the South have been or are now manufacturing or are contemplating the manufacture of peanut oil. The experience and training of the cottonseed-oil manufacturers naturally fit them for this work. The machinery employed in making cottonseed oil is with slight modifications used for peanuts also. Inasmuch as two general types of crude-oil mills are now operating in the South, the hydraulic mill and the expeller or cold-press mill, the production of peanut oil, as could have been expected, has developed in both these types.

Experiments made on a large scale in cottonseed-oil mills in this country have demonstrated that the ordinary box presses and press cloth, with practically no alteration, can be used in making peanut oil either from shelled or unshelled nuts. The expeller type of press also has been used satisfactorily in a number of mills. Most of the oil mills manufacturing peanut oil have used the same methods of grinding, cooking, pressing, etc., that are used for cottonseed oil, but a first-grade oil can not be made from cooked material.

Where the hydraulic press is used for making a high-grade edible oil, it is necessary to clean, shell, blanch, and degerm the nuts, as already mentioned. Then the meats should be ground and rolled in such a way that the oil cells are crushed. The ground material should be pressed cold the first time, in order to produce a high-grade oil. After this first pressing the cake should be ground, heated, and again pressed, as described under the European method of making peanut oil. It will probably not be necessary to make more than two pressings in the American presses.

In a continuous-working machine of the expeller type the peanuts should be treated as mentioned in the preceding paragraph, except that it is not necessary to grind the meats before feeding them into the machine. In the expeller mill there is some difficulty in getting a good yield from shelled nuts, and, as there is less heating of the raw material before pressing, the oil made from unshelled nuts does not have quite as much of the shell taste as is the case in the hydraulic press. Although, when working carefully on a small scale, very good oils have been made from thoroughly cleaned, unshelled nuts, it is very doubtful whether under commercial conditions a high-grade table oil can be produced without shelling and blanching the nuts. The presence of a small quantity of shells in the continuous press helps to increase the capacity of the machine and reduces the amount of "foots" squeezing through the bars with the oil. It is possible, however, so to temper the blanched peas that a good cake, containing as low as 6 per cent of oil, can be produced, together with a fairly clear oil. If, for any reason, only a second-grade oil, which is to be refined or used for soap making without refining, is to be made, it would not be necessary to shell or grind the nuts before feeding to the expeller. The yield of oil and the capacity of the presses can be increased by grinding and tempering instead of feeding the unshelled nuts direct to the machine. In any case where the nuts are not shelled, the stock should be thoroughly cleaned, to remove dirt, stones, trash, etc., as these materials affect the quality of the oil and increase the wear and tear on the machines.

There are some fundamental differences between the peanut and cottonseed as an oil material. The proportion of hull to meat is less in the peanut than in cotton seed, and as the shell of the peanut is more absorbent than cottonseed hulls the loss of oil in pressing unshelled peanuts will be greater than with cotton seed. It is obvious that decortication can be accomplished much more readily with the peanut than with cotton seed.

The really important difference between these two seeds, however, is in the oil itself. Cottonseed oil belongs to that class of vegetable glycerids that have to be refined before they are edible, while peanut oil, if properly pressed from sound stock, has a good color, a sweet, nutty flavor, and is a thoroughly satisfactory table oil just as it runs from the press. There is, of course, more or less insoluble matter, fine particles of the peanut, which have to be taken out to prevent a rapid spoiling of the oil, but this is easily removed by filtering. In this respect peanut oil is like olive oil, the best grade of which appears on our tables just as it comes from the fruit; in fact, just as it existed in the olives themselves.

Old, rancid peanut oils, made from spoiled nuts or from sound nuts improperly treated, can be refined and the disagreeable odor and flavor removed, but such oils are lacking in the characteristic sweet peanut taste of a virgin oil and are inferior for salad and general table purposes. Doubtless the low-grade oils, made from rancid nuts or by a second hot pressing of the cake from which the first-grade oil has been removed, will find a market with the refiner. These, when properly treated, yield a bland oil entirely satisfactory for many purposes, but the loss due to refining and the lower price which such oils command make it desirable to produce as large a quantity as possible of high-grade oil which does not need to be refined. Just how much more a mill can afford to pay for good, fresh stock, how much can be spent in grading, sorting, and cleaning the stock, and what proportion of it should be cold pressed and what hot pressed will depend upon the relative market price for the virgin and refined oils.

At present there is a rapidly-growing demand in this country for a high-grade peanut oil for use as a salad oil. During 1919 about 1,000,000 gallons of high-grade peanut oil was used as salad oil in the United States, and many prefer it to olive oil.

The difference between these two is one of flavor, and just as one person prefers an apple to an orange, so some people will always prefer an oil with a very characteristic taste like olive oil, or a bland oil, such as refined cottonseed oil, to the mild, nutty flavor of peanut oil.

That peanut oils can be satisfactorily refined with as little loss, calculated on the free fatty acid content, as cottonseed oils is undoubtedly true, but that such refined oils will command as high a market price as the virgin oils seems very doubtful.

BY-PRODUCTS OF PEANUT-OIL MANUFACTURE.

The principal by-product of peanut-oil manufacture is the meal, which is a very valuable feed. One ton of farmers' stock Spanish peanuts will yield about 750 pounds of meal if the shelled nuts are used. This meal is exceedingly high in proteins and fat, commands a high price when sold in competition with cottonseed meal and other high protein concentrates, and can be used for all classes of live stock without producing any ill effects. Peanut meal has about the same fertilizer value as cottonseed meal, but its greatest value is for livestock feeding, and when so fed a large proportion of the fertilizing constituents can be returned to the land.

Where the peanuts are shelled before the oil is extracted the hulls may be classed as a by-product. They can be ground with the meal to give bulk, but they add very little to the food value. If not mixed with the feed, they can be used as fuel in the boilers which furnish power for running the mill or they can be sold for bedding for live stock.

ECONOMIC CONSIDERATIONS IN CONNECTION WITH THE MANUFACTURE OF PEANUT OIL.

Much of the peanut oil manufactured in the United States at the present time is sold in competition with and at the same price as crude cottonseed oil, as it is used for the same purposes as cottonseed oil. High-grade peanut oil made for use as a salad oil is sold in competition with and at prices very similar to those received for olive oil. Owing to the spread of the boll weevil and the increasing importance of the peanut in our southern agriculture, it is altogether probable that increasing quantities of peanut oil will be used for purposes formerly met by cottonseed oil.

A bushel of good farmer's stock Spanish peanuts will yield about 1⅛ to 1¼ gallons of oil, and the farmer must receive a sufficient price per bushel to give him a satisfactory return for the labor, seed, fertilizer, etc., used in producing the crop. Before going into the growing of peanuts for oil production, farmers should take into consideration the abnormal conditions prevailing at the present time (1920). Owners of oil mills are now offering a price for peanuts that would justify farmers in growing them. If, however, for any reason cottonseed should become very plentiful, it will, without doubt, affect the prices paid for peanuts. The present indications are, however, that there is little danger that the growing of peanuts will be overdone. The peanut-growing industry should not be started in any section unless it is to be continued for a number of years, for it can not be carried on successfully without proper equipment, and the buying of such equipment for handling the crop will not be justified if the industry is to be dropped after one or two years.

YIELD OF PEANUTS, COST OF PRODUCTION, AND RETURNS.

While the average yield of Spanish peanuts is only about 35 bushels to the acre, any fairly successful farmer will produce 40 to 60 bushels. Yields of 75 to 100 bushels to the acre are not uncommon, and there are records of even higher yields.

The cost of growing an acre of peanuts varies considerably, depending upon the quantity of fertilizer used and the yield secured. The cost of production up to harvest time is practically the same for a low yield as for a high yield, but the cost of harvesting, thrashing, and handling is greater for a high yield. The cost varies widely in different sections of the country, owing to differences in the value of the land, yield secured, and cost of labor and superintendence, and it fluctuates widely from year to year. At present (1920) the cost of growing peanuts is probably twice as great per acre as it was five years ago. At that time the cost of growing an acre of peanuts giving a yield of 40 bushels was from $20 to $30, while at the present time this cost is perhaps $40 to $60 per acre.

In studying the cost of growing peanuts it should be remembered that the following items enter into the question: Rental of land or interest on investment, plowing and fitting the land, seed and planting, fertilizers, cultivation, harvesting and stacking, poles for stacks, picking and hauling to market, bags and twine, depreciation of equipment, such as pickers, planters, etc., and incidentals. Under favorable conditions a half ton of hay will be produced on each acre, and this has a high feeding value, equal to the best clover hay or to alfalfa. In many cases it will be found that the improvement of the soil due to the growing of peanuts and the value of the hay will go a long way toward paying for the growing of the crop. Experiments have shown that 1 ton of farmers' stock Spanish peanuts will yield about 600 pounds of dirt, hulls, and trash, 600 pounds (80 gallons) of oil, and 750 to 780 pounds of cake. The value of this oil will depend on its quality and upon the price of other oils, and the returns to be expected from the growing of peanuts for the making of oil must be determined by a careful study of the costs of growing the crop, as shown by local conditions, when compared with the price received for the nuts or for the oil.

Many of the mills now manufacturing peanut oil are securing only 60 to 65 gallons of oil from a ton of Spanish peanuts. The low yield of oil is to be accounted for by the low grade of nuts used, by not shelling the nuts before expressing the oil, and by the high percentage of oil left in the cake. As a matter of fact, peanuts crushed without shelling return 1,300 to 1,350 pounds of meal, instead of 750 pounds as from the shelled nuts. It should be noted, moreover, that meal made from unshelled nuts is much lower in protein content than that from shelled nuts.

THE PROPER LABELING OF PEANUT PRODUCTS.

In conclusion, a word as to the proper labeling of peanut oil and cake may be of interest to those who will market these products. Good peanut oil is a wholesome, palatable food, and no apologies should be made for its existence. It should be labeled and sold for just what it is and a demand created upon its own merits. The virgin grades, sweet and unrefined, should not be dressed up in foreign-looking labels or called simply salad oil. Call your product "American peanut oil," or, if you want to suggest a use for it, "peanut salad oil." The refined oil should be labeled "refined peanut oil." The American Feed Control officials have tentatively taken the stand that the terms " peanut-oil cake " and " peanut-oil meal " can properly be applied only to the products made from shelled nuts and that when the unshelled peanuts are pressed the cake should be labeled " unhulled peanut-oil feed " and the ingredients designated as " peanut meal and hulls." It would be a great mistake for the manufacturers of this valuable feed to make themselves liable to embarrassing court proceedings because of the fact that a product containing a certain portion of shells was not properly labeled.

SUMMARY.

(1) Peanut oil is one of the most important of the world's food oils.

(2) The United States imported during the first 10 months of 1919 nearly 20,000,000 gallons of peanut oil.

(3) In making high-grade edible oils in Europe the peanuts are cleaned, shelled, blanched, and degermed before being pressed. The first pressing is made without heating the material. After the first pressing the cake is reground and heated for the second pressing. Three pressings are usually made, and in some mills a fourth.

(4) In Europe the best grades of peanut oil are used for edible purposes. The second-grade oil is used largely in the manufacture of margarines.

(5) Of the nine varieties of peanuts grown in the United States, but one variety (the Spanish) should be grown for oil purposes.

(6) In order to make a very high-grade edible oil the peanuts should be thoroughly cleaned, shelled, blanched, and degermed before being pressed.

(7) When using a hydraulic press for expressing peanut oil the cleaned meats are ground and rolled in order to crush the oil cells. In the expeller type of machine the grinding is not necessary.

(8) To make a high-grade peanut oil in a cottonseed-oil mill it will be necessary to install additional machinery. The equipment used in peanut cleaning and shelling factories can be used to advantage.

(9) The presses and expellers used for the making of cottonseed oil are also used for making peanut oil.

(10) The first pressing should be made cold, in order to get a high-grade edible oil which will not need refining. The second pressing should be made after regrinding and heating the cake from the first pressing. It is doubtful whether more than two pressings should be made in this country.

(11) The oil from the first pressing should be a high-grade edible oil. The oil from the second pressing might be refined and used for cooking or for the manufacture of oleomargarine, or it might be used without refining for soap making.

(12) The analyses of a large number of miscellaneous samples of Virginia and Spanish peanuts show a difference in favor of the latter of about 9 per cent in oil content. However, the analyses of five varieties grown under the same conditions show very little difference in the percentage of oil.

(13) Peanut meal, a valuable by-product of oil manufacture, is a highly nutritious stock feed.

(14) The cost of producing peanuts varies widely in different sections of the country and from year to year, depending on the rental of the land or interest on the investment, the cost of plowing and fitting the land, seed and planting, fertilizers, cultivation, harvesting and stacking, picking and hauling to market, bags and twine, and depreciation of the equipment, such as pickers and planters. At present (1920) the cost of growing an acre of peanuts varies from $40 to $60.

(15) Peanut oil and peanut meal should be correctly labeled and advertised for just what they are.

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BUSINESS - INDUSTRY - SCIENCE

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief, and the Bureau of Chemistry, Carl L. Alsberg, Chief.

PEANUT OIL.

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CONTENTS.

	Page.
Introduction	1
The manufacture of peanut oil in Europe	2
Varieties of peanuts grown in the United States	4
The preparation of peanuts for oil making	6
Machinery for manufacturing peanut oil	7
Analyses of American-grown peanuts	7
The manufacture of peanut oil in the United States	10
By-products of peanut-oil manufacture	12
Economic considerations in connection with the manufacture of peanut oil	12
Yield of peanuts, cost of production, and returns	13
The proper labeling of peanut products	15
Summary	15

INTRODUCTION.

A large increase in the acreage of peanuts in the South, especially in the territory infested with the cotton boll weevil, has led owners of oil mills, farmers, merchants, and bankers to look for a new outlet for a part, at least, of the peanut crop. As a result there has arisen during recent years considerable interest in the experimental manufacture of peanut oil in the United States, although up to 1915 little commercial oil was produced; this in spite of the fact that large quantities of peanut oil are imported. Taking the two factors into consideration, namely, an increasing production of peanuts in this country and a considerable import trade in peanut oil, it would seem desirable, if profitable, to convert a portion, at least, of the surplus peanuts into peanut oil and its by-products.

NOTE.—This bulletin will be of interest to owners and managers of oil mills, oil dealers, and business men, and to farmers who are growing or who contemplate growing peanuts.

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Peanut oil is one of the most important of the world's food oils, as is evidenced by the fact that in 1912 over 120,000 metric tons of peanuts in the shell, together with about 240,000 metric tons of shelled nuts, were crushed in Marseille, yielding 15,500,000 gallons of edible oil. In addition to this, about 23,000,000 gallons of inedible peanut oil were produced The same year, Germany imported 68,765 tons of peanuts, practically all of which were used for making oil.

The imports of peanut oil entered for consumption in the United States for the year ended June 30, 1914, amounted to 1,332,108 gallons, valued at $915,939. Almost exactly one-half of this oil was imported through the port of Chicago, which would indicate that a large portion of it was used in the manufacture of oleomargarine.

THE MANUFACTURE OF PEANUT OIL IN EUROPE.

Before discussing the manufacture of peanut oil in the United States a brief description of the raw materials and processes in use abroad may be of interest.

There are at least 10 geographically different varieties of peanuts quoted on the Marseille market. Those from the French colonies of West Africa (Gambia, Rufisque, Kasamanze, Rio Nuez, and Bissagos) are usually imported in the shells, while the shelled nuts come from China, Mozambique, Bombay, and the Coromandel Coast of India. Peanuts in the shell from Rufisque, Soloum, Sina, and Gambia contain from 35 to 36 per cent of oil and yield on a large scale from 28 to 30 per cent of shells and 31½ to 32½ per cent of oil. Figured on the basis of shelled nuts the oil yield is 44 to 45 per cent. The cake usually retains from 8 to 9 per cent of oil. Kasamanze nuts yield 30½ to 31½ per cent of oil. The decorticated Bombay and Coromandel nuts yield 36 to 38 per cent, while those from Mozambique on a practical scale yield 40 to 42 per cent.

The best grades of oil are, of course, made from stock shipped in the shells, as with these there is less opportunity for spoilage during the ocean voyage than with the shelled nuts. The Chinese nuts, which are shelled almost entirely by hand and carefully protected from water or crushing, give a better grade of oil than that obtained from some of the unshelled nuts. Peanuts from India, especially those from the Coromandel Coast, are at present largely shelled by the native method of wetting them down with water so that they open of their own accord, when they are flayed out with clubs. These nuts are not allowed to dry thoroughly before being shipped and consequently undergo heating in transit to Europe, so that as a rule they can not be used for the production of good edible oils, but are worked up for soap stock. The Coromandel nuts are practically all used in this way.

Abroad, almost invariably peanut oil is made from shelled nuts. Mills that buy the nuts in the shells must first shell them by machinery designed particularly for that purpose. The foreign matter, such as sticks and stones, and a small quantity of unshelled peanuts are next removed by running the shelled stock over screens similar to the shakers used in the cotton-oil mills. Then the inner or red skins are removed as completely as possible. These skins, which, strange to say, contain about 14 per cent of oil, are usually saved, added to the refuse meat, and expressed with it, yielding a small quantity of inferior oil. When thoroughly cleaned, the kernels are ground, usually by a system of corrugated rolls which do not crush them as fine as cottonseed is ground in this country.

The ground material is then pressed in what is known as the Marseille press. This is somewhat similar to the ordinary fruit or cider press used in this country, but more powerful. It consists of a piston carrying a platform upon which the square cheeses (meal wrapped in press cloth) are laid, one at a time, each successive cake being separated from the one below it by a thin steel plate. These presses have no protecting sides, or "boxes," such as are usually found in the American hydraulic presses, and the pressure which is applied to the peanuts is much less than that used with cottonseed. When the press is full, the pressure is applied and the material allowed to stand under pressure until a little over half of the oil has been squeezed out. This gives what is known as cold-drawn oil, which is nearly colorless, has a pleasant, nutty taste, and needs no refining to make it suitable for salad or cooking purposes, provided, of course, the original peanut material was clean and free from rancid nuts.

After the first pressing the cakes are taken out of the cloths, reground, and sometimes a small quantity of moisture is added. After being heated for a few minutes new cakes are formed and again pressed. The oil thus obtained is of a quality inferior to that from the first pressing and goes into a low-grade edible oil or prime soap oil. A third pressing usually is made, and in some mills a fourth, before the cake has been exhausted. Both of these pressings are made after regrinding and heating the cake. There is usually about 6 per cent of oil left in the final cake, which according to Bolton and Revis[1] has the following average composition:

	Per cent.		Per cent.
Moisture	10.68	Digestible carbohydrates	30.49
Oil	5.8	Mineral matter	4.06
Woody fiber	3.85		
Albuminoids	45.12		

For edible purposes the European market requires a very light colored oil, and to obtain this it is usually necessary to filter it through fuller's earth or charcoal. If the oil is to be used in making margarine this removal of color is not only unnecessary but undesirable.

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[1] Bolton, E. R., and Revis, Cecil. Fatty Foods, Their Practical Examination, p. 204. London [n. d.].

Within the last few years rapid progress has been made abroad, especially in Marseille and Nice, in the refining and deodorizing of vegetable oils. According to Thompson,[1] in 1912 some 175,000 barrels of Coromandel peanut oil, which would formerly have been considered inedible, was, by refining, put into the edible class. As this oil often runs as high as 25 to 40 per cent of free fatty acid, the refining loss is very high.

In Europe, the very finest grades of peanut oil are used exclusively for edible purposes, and practically all that is produced in France is consumed at home, only second-grade oils being exported to the United States. Probably a large portion of the second-grade edible oil made in France, Germany, and Holland is used by these countries in the manufacture of vegetable margarines, which are mixtures of peanut, coconut, and similar oils ripened with milk. An additional quantity of peanut oil enters into the composition of oleomargarine—that is, margarines which contain animal fats. Since olive oil will not stand the high or continued heating required of oils used in the cooking of such products as sardines, peanut oil is generally used. After the fish have been cooked in the peanut oil, they are drained, put into cans, and the cans filled with olive oil. In addition to these three uses for edible peanut oil, large quantities of the low-grade or inedible oils go into the soap kettles of Europe.

In the United States the consumption of peanut oil as a salad oil for cooking, and in the making of oleomargarines and similar compounds could probably be greatly increased by placing a high-grade edible oil on the market at a price slightly lower than that received for the best brands of imported oil. At the present time there is no established market for a high-grade American-made peanut oil, because very little has been put on the market.

VARIETIES OF PEANUTS GROWN IN THE UNITED STATES.

There are five distinct varieties of peanuts grown in the United States—Spanish, Virginia Bunch, Virginia Runner, Valencia (or Tennessee Red), and African (or North Carolina). While any of these could be used in the manufacture of peanut oil, the Spanish is the best one and is the only variety that should be grown for this purpose. The Spanish peanut is adapted to a wider range of soil and climatic conditions and contains a higher oil content than any other variety, with the possible exception of the Valencia.

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[1] Thompson, E. W. Edible Oils in the Mediterranean District. U. S. Dept. Com., Bur. For. and Dom. Com., Spec. Agent Ser. no. 75, p. 8. 1913.

The following descriptions of varieties may be of interest to those not familiar with them:

Spanish.—A small-podded variety with heavy foliage; stems upright; pods thin, usually well filled, clustered about the base of the plant and adhering well in digging; peas rich in oil. This variety will mature in less time than any other and can be planted after a crop of early vegetables or after oats, wheat, or some other grain crop. The standard weight is 30 pounds per bushel.

Virginia Bunch.—A large-podded variety with rather light foliage; stems upright; pods clustered about the base of the plant. The customary weight per bushel is 22 pounds. As this variety has a lower oil content and a smaller proportion of meats to shell than the Spanish, it should not be grown for oil purposes.

Virginia Runner.—A large-podded variety with heavy foliage; stems creeping; pods scattered along procumbent stems and not adhering well in digging; pods and peas similar to those of the Virginia Bunch peanut. This variety is harder to cure than the bunch types, because the pods are scattered along the stems and can not be as well protected from the weather as the varieties with nuts clustered near the base of the plant. The weight per bushel is 22 pounds.

Valencia.—A small-podded variety with heavy foliage; stems upright; pods long, usually containing three or four peas, but sometimes as many as five or six; peas dull red, darker in color than the Spanish. This variety is a rather heavy yielder, but the pods pull off badly in digging. It is not grown to any great extent in this country.

African (or North Carolina).—A small-podded variety with very heavy dark-green foliage; stems creeping, sometimes having a spread of 3 or 4 feet; pods scattered along procumbent stems and not adhering well in digging; small, a little larger than the Spanish variety, usually containing two peas. As the African peanut produces a larger percentage of "pops," or poorly filled pods, than any other variety and requires a longer growing season, it should not be generally grown.

The Spanish peanut contains a larger proportion of meats to hulls than any other variety. In a shelling test made by the United States Department of Agriculture, farmers' stock Spanish peanuts shelled out 78.70 per cent, the Virginia Bunch 71.15, and the African 71.45 per cent. In this test the trash and dirt usually found in farmers' stock peanuts were not considered. Clean peanuts were selected from an average sample as they are received at cleaning and shelling plants. They were shelled by hand and the meats and hulls were weighed separately. In a commercial shelling plant the percentage of meats secured would probably be at least 10 per cent less than was found in this test, because of the dirt, trash, and "pops," or poorly filled pods; in fact, cleaners are satisfied if they secure 66 to 70 per cent of meats from farmers' stock Spanish peanuts and about 60 per cent for the Virginia type. Shelled Spanish peanuts contain 5 to 10 per cent more oil than the Virginia Bunch and Virginia Runner varieties. The oil content, taken in connection with the difference in the weight per bushel, the habit of growth, quicker maturity, etc., shows that the Spanish is much more valuable for oil production than any other variety of peanut grown in the United States.

In addition to peanuts grown especially for oil purposes, large quantities of low-grade nuts which accumulate at cleaning factories could be used to advantage in making a soap oil or for other industrial purposes. Using this grade of nuts for making oil would serve to increase the price for the better grade nuts, as the low grades would be removed from competition with the high-grade product. Some of the oil mills of the South have been buying low-grade shelled nuts from cleaning and shelling factories and using them for manufacturing peanut oil. The cleaners can afford to sell this product at a low price to oil mills, as food manufacturers are then forced to buy a better grade product for their use. The selling of No. 2 and No. 3 shelled nuts to oil mills recently has raised the price of No. 1 shelled nuts and also of good farmers' stock peanuts.

THE PREPARATION OF PEANUTS FOR OIL MAKING.

Where the very highest grade edible oil is desired, it may be necessary thoroughly to clean, shell, blanch, and degerm the peanuts. Peanuts as received from the farmers usually contain considerable dirt, sticks, and trash of various kinds. These materials must be removed by screens, fans, or suction blasts, such as are used in cleaning and shelling establishments, whether the nuts are to be pressed before or after shelling. Peanuts are usually shelled by machines made especially for this purpose. It is possible that the cottonseed huller can be used for shelling peanuts, but the machine would have to be so adjusted as to give greater clearance space for the peas, to prevent breaking them, and run at a slower speed than for cottonseed. After the nuts are shelled, the peas are separated from the hulls by means of a fan or suction blast. In the regular shellers the hulls and chaff are separated from the meats by suction as they fall from the sheller. This separation could be made in the same manner as they fall from the cottonseed huller.

In order to get the peanut kernels entirely free from trash and bad nuts, it is necessary to hand-pick them. In the cleaning and shelling plants this is done by passing them over a "picking table," alongside of which are seated a number of women, who pick out foreign matter and decayed nuts as the peanuts pass on a slowly moving belt. The cost of this hand picking usually does not exceed $1 per ton of farmers' stock. The hand picking would not be necessary except for a high-grade oil.

The blanching process consists in removing the red skin. The same operation usually separates the pea or kernel into halves and removes the germ, or heart. Blanching is accomplished by means of blanching machines, consisting of a set of brushes revolving against a corrugated plate. The meats are separated from the chaff and germs by passing them over screens and in front of a fan. The skins are blown out and the germs fall through the screen, which should have round holes seven thirty-seconds of an inch in diameter. It is not feasible to remove all of the red skin, but as much as possible should be removed. The germs should also be removed, as the oil in them is of a lower quality than that in the remainder of the nut.

When using a hydraulic press for expressing peanut oil it is necessary to grind the peanuts and run the ground material through rolls to crush the oil cells. The grinding and rolling, or crushing, can be accomplished by using the grinders and rolls now used in cotton-oil mills.

When using a continuous working machine of the expeller type it is not necessary to grind the material, although the cake would have to be ground for the second pressing.

As the germs are quite rich in oil and the skins contain about 14 per cent, these products should not be wasted. They can be used advantageously in the manufacture of low-grade oils, which can later be refined in a manner similar to crude cottonseed oil or used in making soap. Some of the manufacturers of peanut butter and other peanut products are now selling to oil mills for a good price the germs and seed coats, or skins, which are waste in their plants.

MACHINERY FOR MANUFACTURING PEANUT OIL.

In the manufacture of peanut oil in a cottonseed-oil mill it would be necessary to install additional machinery in order to make a high-grade oil. The oil presses, grinders, filter presses, and conveyors in use in cotton-oil mills can be used for making peanut oil. In addition to these machines, it would be advisable to install equipment that is used in peanut cleaning and shelling factories. This equipment consists of cleaning, shelling, and blanching machines and the necessary conveyors, fans, sieves, etc. Dealers in peanut cleaning and shelling machinery can probably furnish all the equipment necessary in preparing peanuts for oil making.

It is probable that machinery made in this country for use in peanut cleaning and shelling plants would be more satisfactory than that used in Marseille. The peanut industry is much more highly developed in the United States than anywhere else in the world, and practically all the machinery used has been designed especially for this purpose.

ANALYSES OF AMERICAN-GROWN PEANUTS.

Unfortunately, the number of analyses of American-grown peanuts is small, but those given in the following tables are fairly representative. More analyses have been made of the Spanish and Virginia than of any other varieties, because they are the most important commercial types. Table I gives the analyses of 12 samples of Spanish and of 19 samples of Virginia peanuts.

TABLE I.—*Analyses of peanuts of the Spanish and Virginia varieties, as grown in the United States.*

Variety.	Source.	Constituents (per cent).			
		Moisture.	Oil.	Oil (dry basis).	Ash.
Spanish:					
Sample a		3.8	50.2	52.2	
Sample b		5.1	50.6	53.3	2.3
Sample c		2.7	52.8	54.3	2.4
Sample d		4.2	47.6	49.7	2.4
Sample e		2.6	49.4	50.7	2.4
Sample f		6.4	48.0	51.0	2.4
Sample g	Mississippi	3.2	50.1	51.8	
Sample h	North Carolina	3.3	48.2	49.8	
Sample i	District of Columbia	3.4	52.2	54.0	
Sample j		6.3	49.0	52.3	
Sample k		1.4	50.4	51.1	
Sample l	Louisiana	4.4	47.4	49.6	
Average		3.9	50.0	52.5	2.4
Virginia:					
Grade No. 1		3.5	43.0	44.5	
Grade No. 3		3.5	45.3	47.0	
Grade No. 1		5.4	41.1	43.5	
Grade No. 2		6.2	38.1	40.6	
Grade Splits		3.4	46.4	48.0	
Grade No. 1		5.1	40.1	42.3	2.0
Do		.5	48.3	48.5	2.0
Do		.6	47.2	47.4	2.1
Grade No. 2		6.3	44.3	46.6	2.3
Do		2.5	45.1	46.2	2.1
Do		1.7	45.2	45.9	2.7
Grade No. 3		7.1	43.8	44.2	3.9
Do		4.0	35.9	37.4	4.4
Do		3.5	35.2	36.5	3.2
Do		6.3	29.8	31.6	
Do		4.7	36.5	38.3	
Farmers' stock		4.1	37.2	38.8	
Do		3.6	45.7	47.4	
Do		4.7	40.0	42.0	
Average		4.1	41.7	43.3	2.7

It will be noticed that the average percentage of oil for the 12 samples of Spanish peanuts is 52.5 and of the 19 samples of the Virginia variety, 43.3, figured on the basis of dry shelled nuts.

As has already been stated, the weight of shells and trash per ton of farmers' stock is about 600 pounds, so that the average amount of oil in a ton of unshelled Spanish peanuts, figured on the basis of 50 per cent of oil, is approximately 700 pounds. Similarly, for Virginia peanuts, which have an average oil content of 42 per cent in the shelled goods and run about 800 pounds of shells and trash to the ton of farmers' stock, there are 500 pounds of oil per ton. The amount of oil present in the average sample of farmers' stock peanuts as received at the mill will usually be slightly less than this, due to the higher moisture content in the raw material.

Assuming that the residual cake will contain 9 per cent of oil, the theoretical yield would be 630 pounds of oil per ton of farmers' stock Spanish and 430 pounds of oil per ton of Virginia peanuts. The laboratory experiments carried on over a series of years by the United States Department of Agriculture, in which peanuts from various sections of the country were pressed in a half-size expeller, indicate that under ideal conditions it is possible to obtain in a single pressing a cake which has as low as 6 per cent of oil, and in one or two instances it has been possible to obtain by a second pressing cakes containing less than 5 per cent. These results apply to both peanuts pressed in the shell and shelled goods. On a larger scale, however, it will probably be impracticable and doubtless undesirable to work for such high yields. The tonnage capacity of the continuous press decreases rapidly when attempts are made to obtain a cake with less than 8 or 9 per cent, and the increased labor and power cost would thus more than offset the increased value of the oil recovered. Laboratory experiments with the continuous press or expeller could not be paralleled with similar runs on a hydraulic press, and the only data available are those obtained from analyses of a few isolated samples of cake. These were obtained from cotton-oil mills, where the peanuts were pressed in their regular hydraulic presses. The oil content of these cakes varies between 7 and 9 per cent.

Analyses of the shelled nuts and of the shells of the five standard varieties of peanuts grown on the same soil at Florence, S. C., in 1915 are given in Table II. These peanuts were grown and analyzed by the department. So far as the writers have been able to learn, these analyses are the only ones ever made of the five types of peanuts grown under identical conditions.

TABLE II.—*Analyses of five varieties of peanuts grown at Florence, S. C.*

Variety.	Constituents of shelled nuts (per cent).					Constituents of shells (per cent).				
	Moisture.	Oil.	Crude fiber.	Protein.	Ash.	Moisture.	Oil.	Crude fiber.	Protein.	Ash.
Virginia Runner	3.35	46.58	2.73	29.60	2.76	5.23	0.73	78.28	5.07	4.11
Virginia Bunch	3.28	45.73	2.84	29.52	3.11	5.23	3.53	70.00	7.25	3.95
Spanish	3.30	49.10	2.30	31.20	2.67	5.03	3.20	66.70	8.16	6.81
Valencia	3.75	49.60	2.13	33.64	2.67	5.80	1.38	70.72	7.23	3.34
African	3.45	45.90	2.26	30.30	3.31	5.45	2.46	71.70	7.60	3.38

It will be noticed that there is very little difference between the oil content of the Valencia and the Spanish and that these two varieties are higher in oil than the other three. The Virginia Bunch, Virginia Runner, and African have nearly the same percentage of oil. The difference in oil content of the five varieties is not very great. In fact, there is as much difference in the percentage of oil in Spanish peanuts grown under different conditions as there is between the different varieties grown under the same conditions, as can be seen by comparing Tables I and II.

It will be noticed that the shells from Spanish peanuts contain less crude fiber and more protein and ash than any other variety. The shells of the Virginia Runner peanuts contain less oil and protein and more crude fiber than any other variety.

THE MANUFACTURE OF PEANUT OIL IN THE UNITED STATES.

To date, very little peanut oil has been manufactured in the United States, because peanuts have been disposed of in other channels of trade at a price higher than could be paid by oil manufacturers. However, on account of the present high price and scarcity of cottonseed several oil mills in the South are now making some peanut oil. If peanut oil is to be manufactured on a large scale in the United States the cotton-oil mills already established will naturally be the ones to go into the business. The experience and training of the cottonseed-oil manufacturers will be valuable in enabling them to solve the new problems which will arise in connection with the manufacture of peanut oil. The machinery in use in cottonseed-oil mills can be used, with a little adjustment and modification, for manufacturing peanut oil. Inasmuch at there are two general types of crude-oil mills now operating in the South, the hydraulic mill and the expeller or cold-press mill, the production of peanut oil may reasonably be expected to develop in both kinds of mills.

Experiments made on a large scale in cottonseed-oil mills in this country demonstrate that the ordinary box presses and press cloth, with practically no alteration, can be used in making peanut oil either from shelled or unshelled stock. The expeller type of press also has been used satisfactorily in a number of mills. Most of the oil mills manufacturing peanut oil have used the same methods of grinding, cooking, pressing, etc., that are used for cottonseed oil, but a first-grade oil can not be made from cooked material.

Where the hydraulic press is used for making a high-grade edible oil, it is necessary to clean, shell, blanch, and degerm the nuts, as already mentioned. Then the meats should be ground and rolled in such a way that the oil cells are crushed. The ground material should be pressed cold the first time, in order to produce a high-grade oil. After this first pressing the cake should be ground, heated, and again pressed, as described under the European method of making peanut oil. It will probably not be necessary to make more than two pressings in the American presses.

In a continuous working machine of the expeller type the peanuts should be treated as mentioned in the preceding paragraph, except that it is not necessary to grind the meats before feeding them into the machine. In the expeller mill there is some difficulty in getting a good yield from shelled nuts, and, as there is less heating of the raw material before pressing, the oil made from unshelled nuts does not have quite as much of the shell taste as is the case in the hydraulic press. Although, when working carefully on a small scale, very good oils have been made from thoroughly cleaned, unshelled nuts, it is very doubtful whether under commercial conditions a high-grade table oil can be produced without shelling and blanching the nuts.

The presence of a small quantity of shells in the continuous press helps to increase the capacity of the machine and reduces the amount of "foots" squeezing through the bars with the oil. It is possible, however, so to temper the blanched peas that a good cake, containing as low as 6 per cent of oil, can be produced, together with a fairly clear oil. If for any reason only a second-grade oil, which is to be refined or used for soap making without refining, is to be made, it would not be necessary to shell or grind the nuts before feeding to the expeller. The yield of oil and the capacity of the presses can be increased by grinding and tempering instead of feeding the unshelled nuts direct to the machine. In any case where the nuts are not shelled, the stock should be thoroughly cleaned, to remove dirt, stones, trash, etc., as these materials affect the quality of the oil and increase the wear and tear on the machines.

There are some fundamental differences between the peanut and cottonseed as an oil material. The proportion of hull to meat is less in the peanut than in cottonseed, and as the shell of the peanut is more absorbent than cottonseed hulls the loss of oil in pressing unshelled peanuts will be greater than with cottonseed. It is obvious that decortication can be accomplished much more readily with the peanut than with cottonseed.

The really important difference between these two seeds, however, is in the oil itself. Cottonseed oil belongs to that class of vegetable glycerids that have to be refined before they are edible, while peanut oil, if properly pressed from sound stock, has a good color, a sweet, nutty flavor, and is a thoroughly satisfactory table oil just as it runs from the press. There is, of course, more or less insoluble matter, fine particles of the peanut, which have to be taken out to prevent a rapid spoiling of the oil, but this is easily removed by filtering. In this respect peanut oil is like olive oil, the best grade of which appears on our tables just as it comes from the fruit; in fact, just as it existed in the olives themselves.

Old, rancid peanut oils, made from spoiled nuts or from sound nuts improperly treated, can be refined and the disagreeable odor and flavor removed, but such oils are lacking in the characteristic sweet peanut taste of a virgin oil and are inferior for salad and general table purposes. Doubtless the low-grade oils, made from rancid nuts or by a second hot pressing of the cake from which the first-grade oil has been removed, will find a market with the refiner. These, when properly treated, yield a bland oil entirely satisfactory for many purposes, but the loss due to refining and the lower price which such oils command make it desirable to produce as large a quantity as possible of high-grade oil which does not need to be refined. Just how much more a mill can afford to pay for good, fresh stock, how much can be spent in grading, sorting, and cleaning the stock, and what proportion of it should be cold pressed and what hot pressed will depend upon the relative market price for the virgin and refined oils.

At the present time there is very little demand in the United States for a high-grade peanut oil, but many who have tried prime cold-pressed peanut oil for salads consider it equal, if not superior, to olive oil. The difference between these two is one of flavor, and just as one person prefers an apple to an orange, so some people will always prefer an oil with a very characteristic taste like olive oil, or a bland oil, such as refined cottonseed oil, to the mild, nutty flavor of peanut oil.

That peanut oils can be satisfactorily refined with as little loss, calculated on the free fatty acid content, as cottonseed oils is undoubtedly true, but that such refined oils will command as high a market price as the virgin oils seems very doubtful.

BY-PRODUCTS OF PEANUT-OIL MANUFACTURE.

The principal by-product of peanut-oil manufacture is the meal, which is a very valuable feed. One ton of farmers' stock Spanish peanuts will yield about 750 pounds of meal if the shelled nuts are used. This cake sells for $30 to $35 per ton. At $30 per ton the meal from a ton of farmers' stock Spanish peanuts would be worth $11.25. The meal is a very high grade feed and can be used for all classes of live stock without producing any ill effects. Peanut meal has about the same fertilizer value as cottonseed meal, but its greatest value is for live-stock feeding, and when so fed a large proportion of the fertilizing constituents can be returned to the land.

Where the peanuts are shelled before the oil is extracted the hulls may be classed as a by-product. They can be ground with the meal to give bulk, but they add very little to the food value. If not mixed with the feed, they can be used as fuel in the boilers which furnish power for running the mill or they can be sold for bedding for live stock.

ECONOMIC CONSIDERATIONS IN CONNECTION WITH THE MANUFACTURE OF PEANUT OIL.

Most of the peanut oil being manufactured in the United States at the present time is sold in competition with and at the same price as crude cottonseed oil. Because of the present high price of cottonseed oil it is possible to make peanut oil and sell it at the price of the former. If, however, the price of cottonseed oil returns to the level of the past five years and the cost of producing peanut oil remains at the current level, peanut oil could not compete with it at the lower price.

A bushel of good farmers' stock Spanish peanuts will yield about 1⅛ to 1¼ gallons of oil, and this would have to sell for 60 cents a gallon to make a profit when 70 cents a bushel is paid for peanuts.

Farmers will not grow peanuts for market unless they feel reasonably sure that they will receive at least 70 cents per bushel, and at this price oil mills would have to put a high-grade oil on the market to make a profit under conditions when the competing product, cottonseed oil, sells at a lower level than at present. In other words, oil mills could not afford to pay 70 cents per bushel for peanuts to make an oil which would sell for 40 to 45 cents a gallon, which price, in recent years under more normal market condition, is considered high for cottonseed oil.

Before going into the production of peanuts for oil purposes, farmers should take into consideration the abnormal conditions prevailing at the present time (1916). Owners of oil mills are offering a price for peanuts that would justify farmers in growing them in 1916. If, however, cottonseed is plentiful and cheap next year the owners of oil mills very likely will not be willing to pay as much for peanuts as they are offering now. The peanut-growing industry should not be started in any section unless it is to be continued for a number of years, for growers will not be justified in buying the necessary machinery for handling the crop if the industry is to be dropped after one or two years.

YIELD OF PEANUTS, COST OF PRODUCTION, AND RETURNS.

While the average yield of Spanish peanuts is only about 35 bushels to the acre, any fairly successful farmer will produce 40 to 60 bushels. Yields of 75 to 100 bushels to the acre are not uncommon, and there are records of even higher yields.

The cost of growing an acre of peanuts varies considerably, depending upon the quantity of fertilizer used and the yield secured. The average cost is about $20 to $25 for a yield of 40 bushels per acre. The cost of production up to harvest time is practically the same for a low yield as for a high yield, but the cost of harvesting, thrashing, and handling is greater for a high yield.

On a 54-acre tract in northern Louisiana the average cost per acre was as follows:

Interest on investment	$8.00
Plowing and fitting land, seed, and planting	5.35
Cultivation	2.35
Harvesting and stacking	2.50
Cutting and hauling poles	1.37
Thrashing and hauling	4.80
Bags and twine	1.05
Total	25.42

The yield of this field was 60 bushels of nuts and 1 ton of hay per acre. The nuts sold for $1 a bushel and the hay for $12 a ton, making a gross return of $72 an acre. Deducting the cost of production, which included the foreman's time, the grower received a net return of $46.58 per acre. At 70 cents per bushel for the nuts the returns would have been as follows:

60 bushels of peanuts, at 70 cents	$42.00
1 ton of hay	12.00
Gross return	54.00
Less cost of production	25.42
Net return	28.58

In most sections of the South, where the average yield of Spanish peanuts is about 35 bushels per acre, the estimated cost of production is as follows:

Interest on investment	$5.00
Plowing and fitting land	2.75
Seed and planting	2.75
Cultivation	2.50
Harvesting and stacking	3.75
Thrashing	3.00
Bags and twine	.75
Hauling	.75
Total	21.25

If the peanuts were sold for 70 cents a bushel and the hay at $12 a ton, the returns would be as follows:

35 bushels of peanuts, at 70 cents	$24.50
Two-thirds of a ton of hay, at $12 per ton	8.00
Gross return	32.50
Less cost of production	21.25
Net return	11.25

It should be borne in mind that the estimate of cost of production includes interest on investment and all labor charges as well as cost of materials. The estimated value of hay is quite low, as good peanut hay has practically the same feeding value as the best clover hay.

Experiments have shown that 1 ton of farmers' stock Spanish peanuts will yield about 600 pounds of dirt, hulls, and trash, 600 pounds (80 gallons) of oil, and 750 to 780 pounds of cake. The value of this oil will depend on its quality and upon the price of other oils. On the basis of 80 gallons of oil per ton of farmers' stock Spanish peanuts, this oil would have to sell for an average price of 60 to 65 cents a gallon in order to justify paying 70 cents per bushel for peanuts. At 60 cents a gallon the oil in a ton of nuts would be worth $48. The returns from a ton of farmers' stock Spanish peanuts used for oil purposes would be about as follows:

80 gallons of oil, at 60 cents	$48.00
750 pounds of meal, at $30 per ton	11.25
Total	59.25

At 70 cents per bushel a ton of Spanish peanuts would cost $46.66. This would leave $12.59 for the manufacturing and selling charges of the oil in 1 ton of farmers' stock Spanish peanuts.

Many of the mills now manufacturing peanut oil are securing only 60 to 65 gallons of oil from a ton of Spanish peanuts. The low yield of oil is to be accounted for by the low grade of nuts used, by not shelling the nuts before expressing the oil, and by the high percentage of oil left in the cake. With a yield of 65 gallons of oil, at the same price of 60 cents per gallon, the return per ton for oil and meal would be $50.25. There would be a difference between the cost and sale price of $3.59, which would not cover the cost of manufacture and distribution. As a matter of fact, peanuts crushed without shelling return 1,300 to 1,350 pounds of meal, instead of 750 pounds as from the shelled nuts. It should be noted, moreover, that meal made from unshelled nuts is much lower in protein content than that from shelled nuts.

THE PROPER LABELING OF PEANUT PRODUCTS.

In conclusion, a word as to the proper labeling of peanut oil and cake may be of interest to those who will market these products. Good peanut oil is a wholesome, palatable food, and no apologies should be made for its existence. It should be labeled and sold for just what it is and a demand created upon its own merits. The virgin grades, sweet and unrefined, should not be dressed up in foreign-looking labels or called simply salad oil. Call your product "American peanut oil," or, if you want to suggest a use for it, "peanut salad oil." The refined oil should be labeled "Refined peanut oil." The American Feed Control officials have tentatively taken the stand that the terms "peanut-oil cake" and "peanut-oil meal" can properly be applied only to the products made from shelled nuts and that when the unshelled peanuts are pressed the cake should be labeled: "Unhulled peanut oil feed" and the ingredients designated as "peanut meal and hulls." It would be a great mistake for the manufacturers of this valuable feed to lay themselves liable to embarrassing court proceedings because of the fact that a product containing a certain portion of shells was not properly labeled.

SUMMARY.

(1) Peanut oil is one of the most important of the world's food oils.

(2) The United States imported during the year ended June 30, 1914, 1,332,108 gallons of peanut oil, valued at $915,939.

(3) In making high-grade edible oils in Europe the peanuts are cleaned, shelled, blanched, and degermed before being pressed. The first pressing is made without heating the material. After the first pressing the cake is reground and heated for the second pressing. Three pressings are usually made, and in some mills a fourth.

(4) In Europe the best grades of peanut oil are used for edible purposes. The second-grade oil is used largely in the manufacture of margarines.

(5) Of the five varieties of peanuts grown in the United States, but one variety (the Spanish) should be grown for oil purposes.

(6) In order to make a very high grade edible oil the peanuts should be thoroughly cleaned, shelled, blanched, and degermed before being pressed.

(7) When using a hydraulic press for expressing peanut oil the cleaned meats are ground and rolled in order to crush the oil cells. In the expeller type of machine the grinding is not necessary.

(8) To make a high-grade peanut oil in a cottonseed-oil mill it will be necessary to install additional machinery. The equipment used in peanut cleaning and shelling factories could be used to advantage.

(9) Experiments made in cottonseed-oil mills in this country show that the presses now in use can be used for making peanut oil.

(10) The first pressing should be made cold, in order to get a high-grade edible oil which will not need refining. The second pressing should be made after regrinding and heating the cake from the first pressing. It is doubtful whether more than two pressings should be made in this country.

(11) The oil from the first pressing should be a high-grade edible oil. The oil from the second pressing might be refined and used for cooking or for the manufacture of oleomargarine, or it might be used without refining for soap making.

(12) The analyses of a large number of miscellaneous samples of Virginia and Spanish peanuts show a difference in favor of the latter of about 9 per cent in oil content. However, the analyses of the five varieties grown under the same conditions show very little difference in the percentage of oil.

(13) Peanut meal, a valuable by-product of oil manufacture, is a highly nutritious stock feed.

(14) Under present conditions oil mills can not afford to pay more than 70 cents per bushel for peanuts to be used in making oil. Under normal conditions they could not afford to pay as much as this unless a higher grade oil is made than is being made at the present time.

(15) The average cost of production of peanuts is $20 to $25 for a yield of 35 bushels per acre. At 70 cents a bushel for the peanuts and $12 a ton for the hay the gross returns would be $32.50.

(16) At 70 cents a bushel for Spanish peanuts the oil must sell for 60 to 65 cents per gallon in order to make a profit, figured on the basis of 80 gallons of oil per ton of peanuts.

(17) Peanut oil and peanut meal should be correctly labeled and advertised for just what they are.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1916

THE FALL ARMY WORM, OR "GRASS WORM," AND ITS CONTROL

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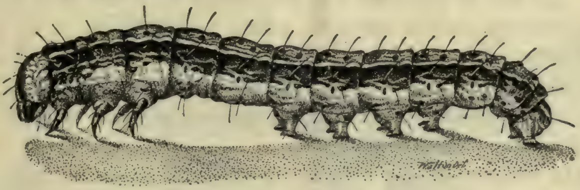
Entomological Assistants, Cereal and Forage Insect Investigations



FARMERS' BULLETIN 752
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. **November, 1916**

IN PRACTICALLY all cases where the fall army worm commits serious injuries to cultivated crops the damage can be prevented if the farmer is on the alert to discover the insects when they first appear.

Every farmer should possess a practical spraying outfit. He should also keep on hand at all times a few pounds of one of the standard insecticides, such as arsenate of lead, Paris green, or arsenite of zinc.

The farmer should cultivate a spirit of suspicion with regard to this insect and realize that the finer the stand of young grain, the more tempting the bait for the army worm, and that a field of corn, beautiful, green, and rustling in the breeze, may at the same time have millions of young army worms devouring the crab grass between its rows, easily controlled if sprayed with arsenicals to-day, but which by to-morrow may have caused irreparable damage to his crops. In such cases a delay of twenty-four hours in securing advice or insecticides is usually fatal.

THE FALL ARMY WORM,[1] OR "GRASS WORM," AND ITS CONTROL.

CONTENTS.

	Page.		Page.
Introduction	3	When invasions may be expected	6
General description	3	Life history	6
Where the fall army worm occurs	4	History of the fall army worm in the United States	9
Economic importance and manner of injury	4	Natural enemies	9
Crops attacked	5	Wild bird and other enemies	2
Where invasions of the fall army worm originate	5	Control measures	12

INTRODUCTION.

This bulletin has been prepared with the intention of supplying the farmer and others with the necessary information for the control of the fall army worm (see illustration on title-page), together with a brief natural history of the species.

This pest, which should not be confused with the true army worm,[2] is known, throughout the range of its injurious abundance, under many different names, some of which are the "grass worm," "overflow worm," "southern army worm," "Daggy's corn worm," "grass army worm," "alfalfa worm," etc. In Texas it is frequently called the "budworm." It is known in the North as the fall army worm because it occurs north of the Mason and Dixon line only in the late summer and fall. However, the injury inflicted by it under any of these names is usually disastrous to the farmer.

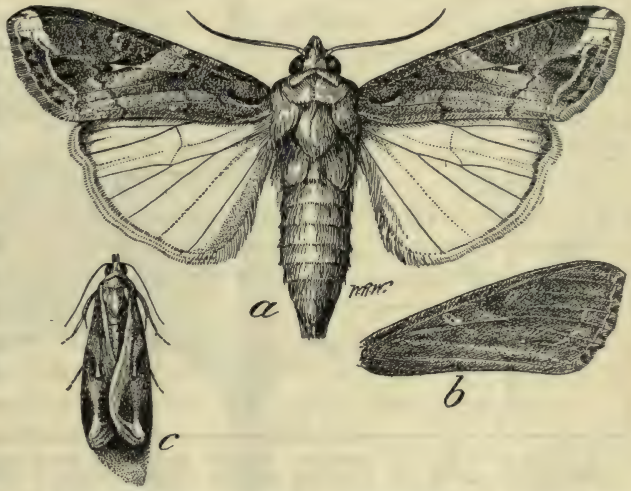


FIG. 1.—The fall army worm: *a*, Male moth; *b*, right front wing of female both; *c*, moth in resting position; *a*, *b*, about twice natural size; *c*, very slightly enlarged. (Original.)

GENERAL DESCRIPTION.

The adult or parent of the fall army worm (fig. 1), a grayish moth, or "miller," is seldom noticed, and the farmer is far more likely to see the full grown, nearly bare, striped caterpillars (fig. 1), his attention being called most forcibly to them by the widespread injury which they produce.

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[1] *Laphygma frugiperda* S. and A.; order Lepidoptera, family Noctuidae.

[2] The true army worm, *Cirphis unipuncta* Haw., is treated in Farmers' Bulletin 731.

WHERE THE FALL ARMY WORM OCCURS.

During periodical outbreaks the fall army worm is found throughout almost the entire United States east of the Rocky Mountains, from Texas to Montana in the West and from Florida to Maine in the East. (Fig. 2.) It has also occurred recently in the Salt River Valley and at Yuma, in Arizona. Ordinarily it is apparently confined to the Gulf States, but under conditions favorable to its development this pest spreads northward as the summer advances, multiplying to such an enormous extent as to cause widespread and immense damage to cultivated crops throughout its range.

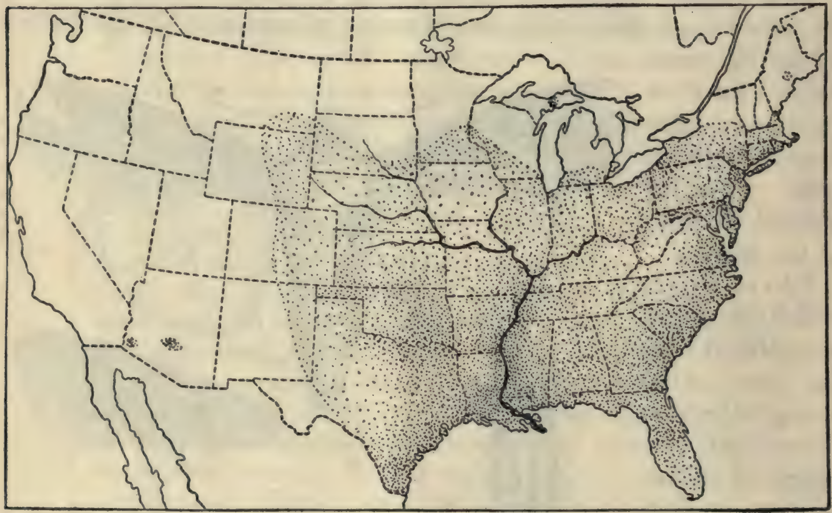

FIG. 2.—Map showing area sometimes invaded by the fall army worm. In the extreme southern portions of this area the fall army worm is always present. (Original.)

This pest is present every year in Central America, Mexico, and the West Indies Islands, and it seems quite possible that our worst outbreaks of the insect originate in these regions.

ECONOMIC IMPORTANCE AND MANNER OF INJURY.

The economic importance of this periodical invader, in the corn and cotton growing sections of the United States, can scarcely be exaggerated. The damage done by it in the Southern States during 1912 alone was enormous.

The caterpillars are exceedingly voracious in their nearly full-grown stage and devour stupendous quantities of food, eating almost continuously until they are ready to change to the adult form. They usually feed more actively at night than during the daylight hours and more on cloudy days than on those during which the sun is shining brightly; but when they are numerous and food is not plentiful they may be seen many times taking or seeking food all day long, even in bright sunny weather.

CROPS ATTACKED.

The fall army worm attacks a great variety of crops, but its favorite food plants undoubtedly are the native grasses such as quack or crab grass, Bermuda grass, bluegrass, Johnson grass, etc. Where these plants are present in abundance it seldom attacks cultivated crops, and this serves to emphasize the necessity of clean cultivation, especially as regards corn, which is usually attacked only after the wild grasses, allowed to flourish between the rows, have been consumed. When the worms are observed feeding on such grasses these should be sprayed immediately with a solution of powdered arsenate of lead, 1 pound, or arsenite of zinc, 1 pound, to 50 gallons of water, in order to kill them before they attack the corn.

Besides corn, among cereal and forage crops, the fall army worm seriously injures kafir, rice, oats, millet, alfalfa, clover, sorghum, and cowpeas. The caterpillars are very fond of young sorghum. In the South, where it is a common practice to plant sorghum and cowpeas together for a hay crop, these worms frequently devour the sorghum plants from among the cowpeas—leaves, stem, and all, down to the very ground.

Cotton is severely injured at times, the caterpillars frequently cutting the tops of the plants completely off. Among other cultivated plants sometimes attacked are potato, sweet potato, turnip, spinach, tobacco, tomato, cabbage, cucumber, and grape. A full list of its occasional food plants would occupy so much space as to be out of place in this publication. In the cities of the North the fall army worm often devours the grass on lawns so rapidly as to cause consternation and astonishment to the owners.

WHERE INVASIONS OF THE FALL ARMY WORM ORIGINATE.

This insect is undoubtedly a native of tropical or subtropical America. It is apparently unable to survive the winter north of southern Georgia or central Texas, and, for this reason, is able to spread throughout the regions commonly visited by severe frosts only during the warmer portions of the year. During the years of its greatest abundance in the Southern States large numbers of the parent moths fly northward, by the aid of favorable winds sometimes making flights of hundreds of miles. After such flights the moths evidently lay their eggs at some chosen spot, the eggs hatch

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and a fresh outbreak begins, and the female moths developing from the larvæ again fly northward before depositing their eggs. In this manner the fall army worm during favorable summers manages to spread over the entire eastern portion of the United States, even reaching southern Canada before the severe frosts of autumn intervene and halt its northward flight.

WHEN INVASIONS MAY BE EXPECTED.

General invasions of the fall army worm occur almost invariably following cold, wet springs. In some parts of the Mississippi Valley the pest is known as the "overflow worm," since the farmers attribute outbreaks of the insect directly to the overflowing of the great river, and it should be stated that there is evidence which appears to support this belief. The effects of cold and dampness on the insect enemies that ordinarily control the fall army worm are apparently disastrous, while such conditions have little or no ill effect on the caterpillars of the pest. It may be for this reason that local outbreaks occur nearly every year in the South in scattered localities after periods of heavy, localized rainfall and humid weather.

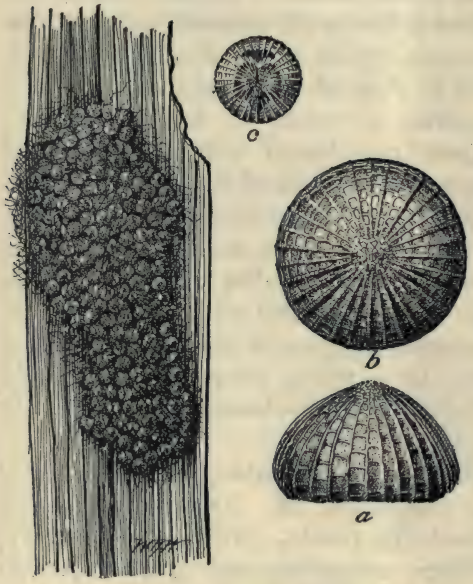

FIG. 3.—Eggs of the fall army worm: Egg mass at left about twice natural size; *a*, highly magnified egg, side view; *b*, same, view from above; *c*, greatly enlarged egg about ready to hatch, larva showing through the shell. (Original.)

LIFE HISTORY.

The fall army worm, in common with many other insects, passes through four stages in its development: First, the egg; then the larva, or caterpillar, which is the stage of growth and injury to crops; then the pupa, or resting stage; and, finally, the stage of the moth, or mature insect.

THE EGG STAGE.

The eggs (fig. 3) are laid by the moths at night in clusters of from 50 to several hundreds, preferably on grass blades. Low-lying fields thickly covered with grass or small grains are often chosen for this purpose, and hence the outbreaks usually originate in bottom land. Sometimes, however, especially in cities, the eggs are laid among the grass blades on lawns. The color of the eggs is light gray and they are always more or less thickly covered with grayish down from the moth's body. The eggs hatch in from 2 to 4 days in the South, but sometimes require 10 days in the cooler climate of the Northern States.

THE CATERPILLAR, OR LARVAL, STAGE.

The newly hatched caterpillars (fig. 4) are very small and have jet-black heads and white bodies. They feed near the surface of the ground; thus, although myriads of them may be present, they are hidden from sight, and as they consume comparatively little food at this stage of their development the farmer does not often become aware of their presence. They feed first upon the shells of the eggs which have contained them, but soon begin to devour the crop. If the infestation is discovered at this time it usually can be brought quickly to an end by spraying with insecticides, or by mowing off the crop and then covering the infested spots with straw and burning them over.

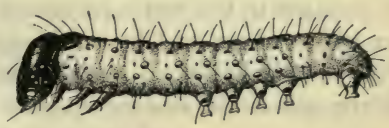
FIG. 4.—The fall army worm: Newly hatched larva, or "worm." Greatly enlarged. (Original.)

Within three or four days after hatching the young caterpillars have grown rapidly, turned much darker in color, and have begun to do considerable damage to the crop. At this time they do not entirely consume the leaves of the food plant, but skeletonize them, leaving the veins and ribs and whitish patches, which are conspicuous when seen against the green of the healthy portions of the leaf. The larvæ may be found in a curled position in the leaf sheaths, or possibly suspended by threads, but more than likely they will be found on the ground underneath the injured plant. The prompt application of arsenicals at this time is an easy matter, and is very effective in controlling the pest.

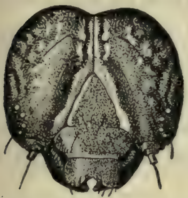
FIG. 5.—The fall army worm: Head of larva, front view. Greatly enlarged. (Original.)

From two to three weeks after hatching the caterpillar becomes fully grown. It is then striped, nearly naked, and about 1½ inches in length. (See title-page.) In this stage the fall army worm resembles the caterpillar of the true army worm so closely that it is practically impossible for the farmer to distinguish them. The caterpillar of the fall army worm usually has the front of the head marked with a more or less distinct inverted Y (fig. 5), but this character is not always sufficiently well marked to serve as a reliable means of identification, as this caterpillar varies in color from light greenish to almost black. In their last stages of growth the fall army worms consume quantities of food which are really vast in comparison with their size. By this time they are devouring every blade and leaf, leaving only the toughest parts of the plant stems uneaten. If the appetite of the worms is still unsatisfied when all of their local food supply has been eaten they mass together and crawl or "march" in search of other crops, and this affords the farmer an opportunity of killing the pest in great numbers by one of the mechanical methods described on pages 14 and 15.

When the caterpillar of the fall army worm becomes full grown it changes to the resting stage, or pupa. As a usual thing, practically an inch or two, and by twisting and turning presses the earth away from the body on all sides, thus forming a small cell, within which it changes to the resting stage or pupa. As a usual thing, practically all the worms enter the soil at about the same time, and their sudden disappearance frequently causes astonishment and mystification to the uninitiated observer. After the cell is completed the caterpillar begins to shrink in length, and presently the skin splits and is shed and the pupa appears already formed beneath it.

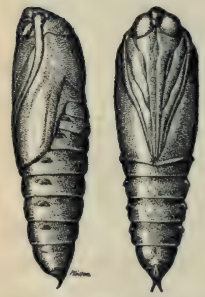

FIG. 6.—The fall army worm: Pupa. About twice natural size. (Original.)

THE PUPA, OR RESTING, STAGE.

The pupa (fig. 6) of the fall army worm is somewhat similar to a shelled peanut or date seed in shape and size, but is rounded at one end and pointed at the other. The color at first is golden or reddish, but finally becomes almost black. The skin or covering of its body is smooth and leathery, and it has no legs and is unable to move any portion of its body but the tail, or abdomen.

If the soil containing these pupæ can be lightly cultivated at this time, the insects are easily destroyed, for their underground cells are broken up and the pupæ are thus crushed or exposed to the action of the sun, rain, and their wild-bird and other enemies.

The resting, or pupal, stage lasts from ten days to two weeks; then the skin of the pupa is burst and the moth or parent crawls forth and makes its way immediately to the surface of the ground.

THE MOTH, OR PARENT, STAGE.

The moth of the fall army worm is somewhat smaller than that of the true army worm, measuring about ¾ inch in length and a little less than 1½ inches across its outspread wings, and these wings are totally different in hue. The front wings (fig. 1) are dark gray in ground color and have a mottled appearance, and there is usually an irregular white or light-gray spot near their extreme tip. The front wings of the female (fig. 1, *b*) are usually much duller in color than those of the male. The hind wings of both sexes are white, but possess a pearly or pinkish luster; they are edged with a smoky brown line. The body of the moth is ash gray.

In the Gulf States there may be as many as six generations of moths in a given locality in one year, but five is probably the more usual number. In those regions where the winter temperatures descend much below the freezing point there is seldom or never more than one generation of the fall army worm in a given locality in any one year, as the moths resulting from an outbreak of the caterpillars almost invariably fly northward, sometimes for hundreds of miles, before laying their eggs. Thus, as the insects can not survive the winter in the North, this is the sole means of infestation for the Northern States, and if it were possible thoroughly to control the fall army worm in the Gulf States during the early spring, farmers in the North would probably never suffer from its ravages. As yet, however, no effective means of doing this has been discovered.

HISTORY OF THE FALL ARMY WORM IN THE UNITED STATES.

The fall army worm has been known as an injurious insect in Georgia since the year 1797 and perhaps earlier than this. It is recorded as having been particularly injurious in Florida in 1845, and it was at this time that the ditching method of destroying the "marching" worms, now in universal use, was first put into practice. In 1870 the insect was injurious in Missouri and Illinois and from then until 1899 more or less extensive damage by it occurred every few years. During the latter year an extensive outbreak of the pest occurred throughout South Carolina, North Carolina, Virginia, West Virginia, Indiana, Illinois, Missouri, Kansas and other western and northern States. The most severe general outbreak of this insect ever recorded occurred during the summer of 1912, when it swept almost the entire United States east of the Rocky Mountains, utterly destroying the corn and millet in parts of many southern States, severely injuring cotton and truck crops, and destroying the grass on lawns in cities as if by magic.

NATURAL ENEMIES.

INSECT ENEMIES.

Fortunately the fall army worm has several very efficient insect enemies which ordinarily succeed in keeping its numbers down, thus preventing serious outbreaks of the pest, except during years when exceptionally favorable conditions for the worm prevail.

In the southern portion of the country several wasplike enemies are always present, one of the most effective of these being a small, black creature (fig. 7) which lays its eggs in the egg deposited by the fall army worm moth. Strange to say, instead of destroying this egg the young parasite remains inactive until the caterpillar has hatched and is partly grown, whereupon it devours the inside portions of the caterpillar's body, killing the pest.

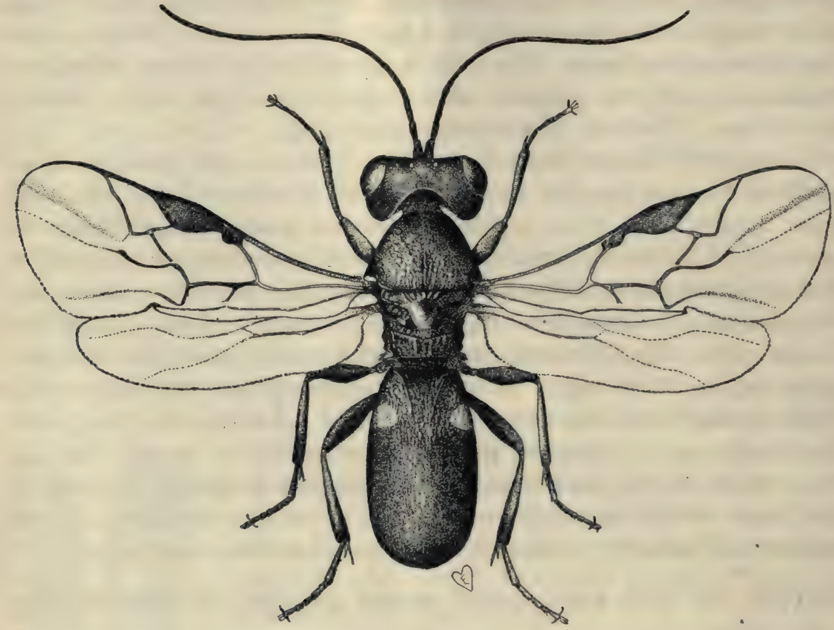

FIG. 7.—*Chelonus texanus*, a parasite of the fall army worm. Greatly enlarged. (Original.)

Other valuable and effective insect enemies belong to a family of two-winged flies, not distantly related to that detested pest, the house fly. Some of these (see fig. 8) deposit their eggs on the bodies of the caterpillars, and the resultant maggots bore into the

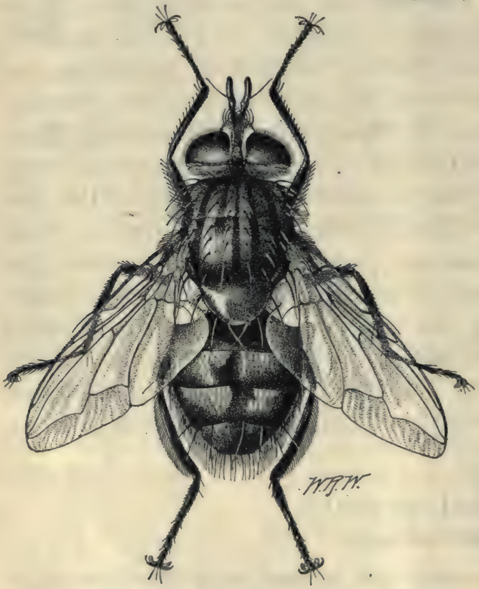

FIG. 8.—*Winthemia quadripustulata*, a fly parasitic on the fall army worm: Adult. Much enlarged. (Walton.)

caterpillar, soon killing it by devouring its internal organs and tissues. Another of these flies (fig. 9) lays exceedingly tiny eggs on the food plant of the fall army worm, which are swallowed by the unsuspecting caterpillar and hatch within its body, the maggots thereupon devouring the worm at their pleasure. Soldier bugs are numerous in some portions of the fall army worm's range. One of these, known as the spined soldier bug (fig. 10), kills and devours the caterpillars by piercing them with its strong beak and sucking out the liquid contents of their bodies. Both the old and young (fig. 11) bugs have this habit and are active enemies of the fall army worm.

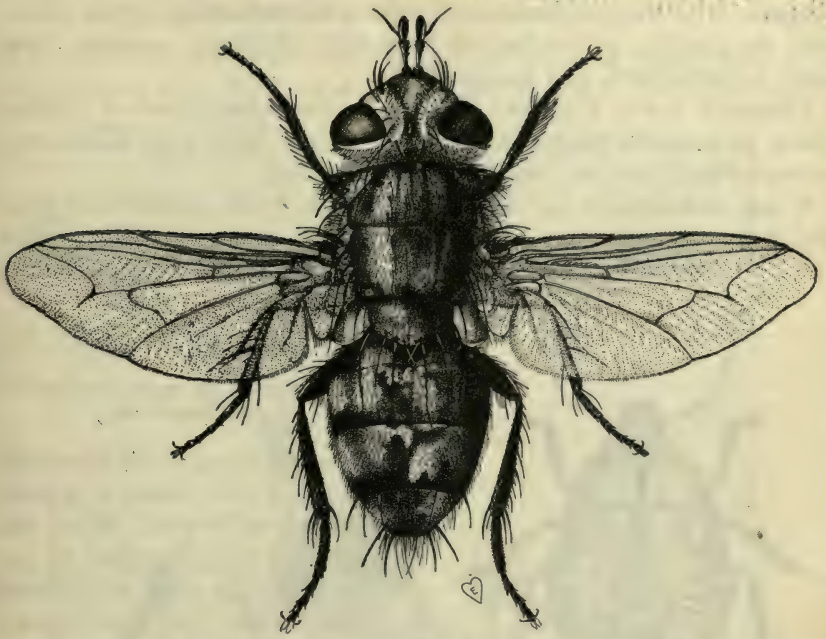

Fig. 9.—*Archytas piliventris*, a fly parasitic on the fall army worm. Greatly enlarged. (Original.)

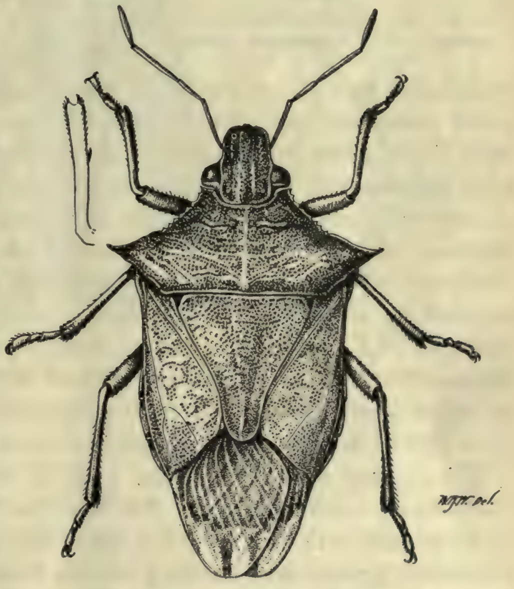

Fig. 10.—The spined soldier bug (*Podisus maculiventris*), an enemy of the fall army worm: Adult bug. Greatly enlarged. (Original.)

WILD-BIRD AND OTHER ENEMIES.

Among the important enemies of the fall army worm are our common wild birds. Some of these are the following: Crow blackbird or grackle, yellow-headed blackbird, chipping sparrow, bluebird, mocking bird, and meadowlark.

Domestic fowls will feed readily on the caterpillars if allowed access to infested fields, but will, of course, take only those individuals which they can reach from the ground.

Toads undoubtedly eat many caterpillars, while skunks feed upon the insects in both larval and pupal stages and are of far greater value to the farmer in this manner than is generally realized.

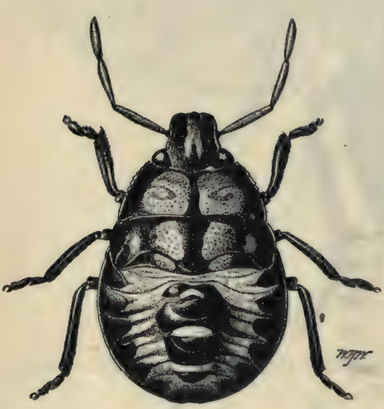

FIG. 11.—The spined soldier bug: Nymph, or young. Greatly enlarged. (Original.)

CONTROL MEASURES.

THE IMPORTANCE OF WATCHFULNESS AND PREPAREDNESS.

In practically all cases where the fall army worm commits serious injuries to cultivated crops the damage can be prevented if the farmer is on the alert to discover the insects when they first appear. Every farmer should possess a practical spraying outfit. Such outfits are not necessarily expensive, as they may be purchased at prices to suit almost any pocketbook. He should also keep on hand at all times a few pounds of one of the standard insecticides, such as arsenate of lead, Paris green, or arsenite of zinc. These are reliable and may be kept indefinitely without loss or deterioration in closed containers. A copy of Farmers' Bulletin No. 127 should be at hand, as this publication, which can be secured free of charge by application to the Secretary of Agriculture, tells how to mix and apply insecticides in controlling all classes of injurious insects. By observing these precautions and keeping a constant watch over his growing crops, the farmer should be in a position to meet invasions of fall army worms or other caterpillars and easily vanquish these pests before they have had a chance to commit serious damage to his crops.

The farmer should cultivate a spirit of suspicion with regard to this insect and realize that the finer the stand of young grain, the more tempting the bait for the army worms, and that a field of corn, beautiful, green, and rustling in the breeze, may at the same time have millions of young army worms devouring the crab grass between its rows, easily controlled if sprayed with arsenicals *to-day*, but which by to-morrow may have caused irreparable damage (fig.

12) to his crops. In such cases a delay of 24 hours in securing advice or insecticides is usually fatal.

SPRAYING FOR THE FALL ARMY WORM.

If the worms are found feeding in crab grass or other grasses or on grasslike grains other than corn, where the stand is not too thick for the worms to be reached easily by the insecticide, they should be sprayed with a mixture of 1 pound of powdered arsenate of lead to 50 gallons of water, or, if the paste form of lead arsenate be used, 2 pounds to 50 gallons of water.

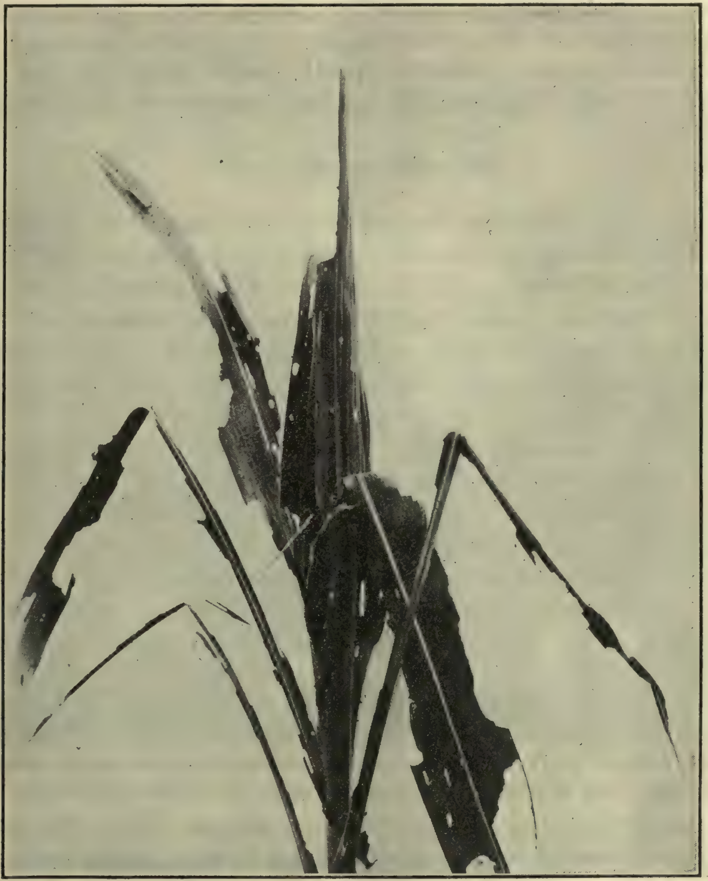

FIG. 12.—Corn plant, showing severe injury by the fall army worm. (Original.)

When feeding on corn the worms usually attack the bud of the plant first and are more difficult to reach because of the hairiness of the corn leaves. In this case a mixture of 2 pounds of powdered arsenate of lead or 3 to 4 pounds of the paste to 50 gallons of water is required, and the spray should be applied so as to force the fluid deep into the bud of the corn in order to reach the worms feeding there. Paris green is sometimes used in place of arsenate of lead, but it should never be sprayed on corn unless lime has been added to it as follows: Paris green, 10 ounces; freshly slaked lime, 2 pounds; water, 50 gallons. If the poison is applied without the lime it will ruin the corn by burning.

White arsenic should never be applied to growing crops in any form, as it is strongly caustic and will burn them. Arsenite of zinc may be safely used as a spray in the proportion of 1 pound to 50 gallons of water if 1 pound of freshly slaked lime is added to the mixture. It may be applied in the same manner as the arsenate of lead spray.

THE POISONED-BRAN BAIT.

Under some conditions the poisoned-bran bait is of the greatest value in controlling the fall army worm. It is composed as follows: Wheat bran, 50 pounds; Paris green or white arsenic, 1 pound, or powdered arsenate of lead, 2 pounds) ; low-grade molasses, or "blackstrap," 2 gallons. The bran and insecticide are first mixed together dry, the molasses is then added, and the whole mass is thoroughly combined. In locations where the mixture dries out quickly, salt at the rate of 5 pounds to 50 pounds of bran tends to keep the bait in a moist condition and renders it more effective. In some cases the addition of six finely chopped lemons or oranges to the mixture has been found to be advantageous. The bait is usually scattered broadcast over the infested fields and seems to be especially effective when the caterpillars are "marching," or in fields where their preferred foods, such as the wild grasses, are not present or have been partly consumed.

MECHANICAL MEANS OF CONTROL.

When the fall army worm has exhausted its food in a restricted locality and the worms have massed together and "marched" away seeking a fresh supply of provender, a narrow ditch with steeply sloping sides should be dug or plowed out directly across the path of the marching worms. In attempting to cross this ditch the worms will gather in great quantities therein and may be destroyed easily by crushing them with a log dragged back and forth through the ditch. (Fig. 13.) Shallow postholes dug at frequent intervals in the bottom of the furrow will trap many worms, which then may be destroyed by crushing or otherwise. Where the subsoil is but slightly permeable, the holes may be partially filled with water and a layer of coal oil, or petroleum, maintained upon its surface. The coal oil will soon kill the worms that fall into the fluid.

SUMMARY OF CONTROL MEASURES.

(1) Provide yourself with a spraying apparatus and keep on hand several pounds of some standard insecticide such as arsenate of lead, arsenite of zinc, or Paris green.

(2) Watch carefully the grass growing among the cultivated field crops in the bottom lands or in the low places of the fields and upon the first indication of the presence of these caterpillars apply poison spray as recommended in this bulletin.

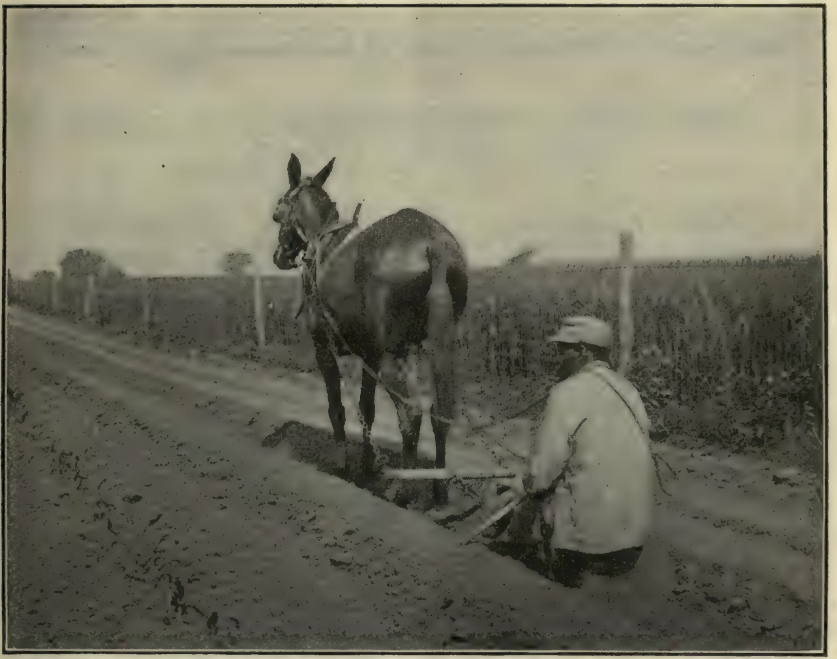

FIG. 13.—Ditch prepared to entrap marching army worms. A log, dragged back and forth through the ditch, crushes the worms that have fallen into it. (Walton.)

(3) In case of a general invasion, after the caterpillars have gone down into the ground in order to change to the next stage, which is the pupa, give the ground a light cultivation, wherever this is possible. This will cause the death of many of the fall army worm pupæ.

(4) When the caterpillars are on the march, or are starting in on one corner of a field of grain, head them off by plowing a deep furrow directly in front of them. Then kill the larvæ falling into this furrow by dragging a log through it. Where the whole field is infested, plow a furrow around it so as to keep the worms out of the surrounding fields. Keep the furrows free from rubbish so that the larvæ will have no means of crossing to the farther side.

(5) Spray infested grass and other vegetation that has no value with a mixture of Paris green and water, 2 pounds of the former to 50 gallons of the latter. Do not use the sprayed grass or vegetation for forage.

Spray growing grasses and other forage crops intended for use at a considerably later date with one of the following mixtures:

(*a*)	Arsenate of lead (powder form)	1 pound.
	Water	50 gallons.
(*b*)	Arsenate of lead (paste form)	2 pounds.
	Water	50 gallons.

When corn is infested, apply one of the following poisonous mixtures:

(*a*)	Arsenate of lead (powder form) (Or paste form, 4 pounds.)	2 pounds.
	Water	50 gallons.
(*b*)	Paris green	1 pound.
	Lime (freshly slaked)	2 pounds.
	Water	50 gallons.
(*c*)	Arsenite of zinc	1 pound
	Lime (freshly slaked)	1 pound.
	Water	50 gallons.

Never use white arsenic on plants; it will burn them.

(6) An immense amount of good can be accomplished in destroying these worms by the use of a poisoned bait which is scattered broadcast over the infested fields. Take 50 pounds of bran and mix with it either 1 pound of Paris green or 2 pounds of lead arsenate, then add 2 gallons of low-grade molasses and 6 finely chopped lemons. This is especially recommended for fields containing mixtures of grass and cowpeas, cowpeas and sorghum, or fields in which grass has been consumed by the caterpillars.

CAUTION: Do not pasture stock in fields where the grass or other crops have been sprayed with a poison mixture until after heavy rains have fallen and not before three weeks after the application of the insecticides.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 753 NOVEMBER 1, 1916

Contribution from the Office of Markets and Rural Organization, Charles J. Brand, Chief.

COMMERCIAL HANDLING, GRADING, AND MARKETING OF POTATOES.

By C. T. MORE, *Investigator in Market Grades and Standards, and* C. R. DORLAND, *Assistant in Market Grades and Standards.*

CONTENTS.

Page.
Introduction 1
Handling southern early or "new" potatoes 2
Handling northern late potatoes 10
Need of standardization 18
Improvement through cooperative organizations 22
Containers 23
Brands 26
Marking packages of potatoes to show quantity of contents 26
Loading cars 26
Marketing 29
Railroad billing 36
Shrinkage 38
Weighing 39
Summary 39

INTRODUCTION.

While potatoes are widely planted in nearly all States for use on the farm or in neighboring markets, the commercial crop moves from relatively definite, restricted areas, as shown in the accompanying illustration. (See fig. 1.)

The larger part of this crop must be transported to market by rail and a large portion of the commercial movement enters into interstate traffic; thousands of carloads are transported long distances, and a very large portion of these potatoes are marketed in an unsatisfactory condition, because of careless handling and little or no grading. Such potatoes are unsatisfactory to shippers, wholesalers, retailers, and certainly to consumers. The railroads, too, are vitally affected, especially when rejected cars stand on track for days and weeks, the contents often bringing less than freight charges. This is most likely

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NOTE.—This bulletin should be of interest to all growers of potatoes and especially to commercial growers and shippers of the United States who are interested in the most desirable methods used in the handling and marketing of the crop.

to occur when the roads are the busiest in the fall harvest season and when they have the greatest need for their cars. Quantities of cull and spoiled potatoes are sometimes left in the cars or thrown out along the tracks, emphasizing the vital need of careful handling, better grading, and fixed, uniform standards of quality.

HANDLING SOUTHERN EARLY OR "NEW" POTATOES.

The early crop moves chiefly from California, Texas, Florida, North and South Carolina, Virginia, Maryland, New Jersey, Kentucky, Kansas, Oklahoma, Arkansas, and Louisiana. Typical sections are those of Florida and the Eastern Shore of Virginia, and as many of the methods used in these sections might be profitably adopted in other sections, their harvesting methods are here described.

Florida.—The principal potato-shipping section of Florida is located about Hastings. In 1915 this section shipped about 1,800 carloads between May 1 and June 1. The principal variety grown is the Rose No. 4. The potatoes are dug mostly with forks and not machine diggers, one reason being that there are not a sufficient number or large enough mules to work satisfactorily with the diggers. When digging with forks the potatoes from two rows are thrown together into one row. In all southern sections potatoes should invariably be picked and loaded into cars as soon after digging as possible in order to avoid sunburn and the consequent decay. The old method was to make two or three pickings, the first picker taking up only the No. 1 grade, the next the No. 2 grade, and then if the market warranted shipping the No. 3 grade or culls, they also were gathered. In 1915, however, it is said about 60 per cent of the crop was run over the type of sizing machine shown in figure 2. Where the sizing machine is used, potatoes are picked into the slat crates holding about 50 pounds, also shown in figures 2 and 6. They are then hauled to the machine, which is placed in some convenient part of the field, in the grower's barn, or under a shed, where they are run over the sizer, from which they fall into barrels. The barrels are then headed and hauled to the car.

The sizing machine in the illustration, consisting of three sorting or sizing belts, is being run by hand, but it may easily be fitted up as a power machine. The potatoes are emptied from the crates on to the apron of the sizer, as shown on the left end of the machine, and they slide down and on the first belt. This top belt of $1\frac{13}{16}$-inch mesh carries all the No. 1 potatoes up the incline over the end of the belt and they drop through the chutes into the barrels for No. 1 grade. The No. 2 and smaller potatoes drop through the $1\frac{13}{16}$-inch or top belt on the second belt of $1\frac{1}{2}$-inch mesh. Here the No. 2's are carried up the incline and drop through the chute on one side into barrels. When the market will warrant shipping the

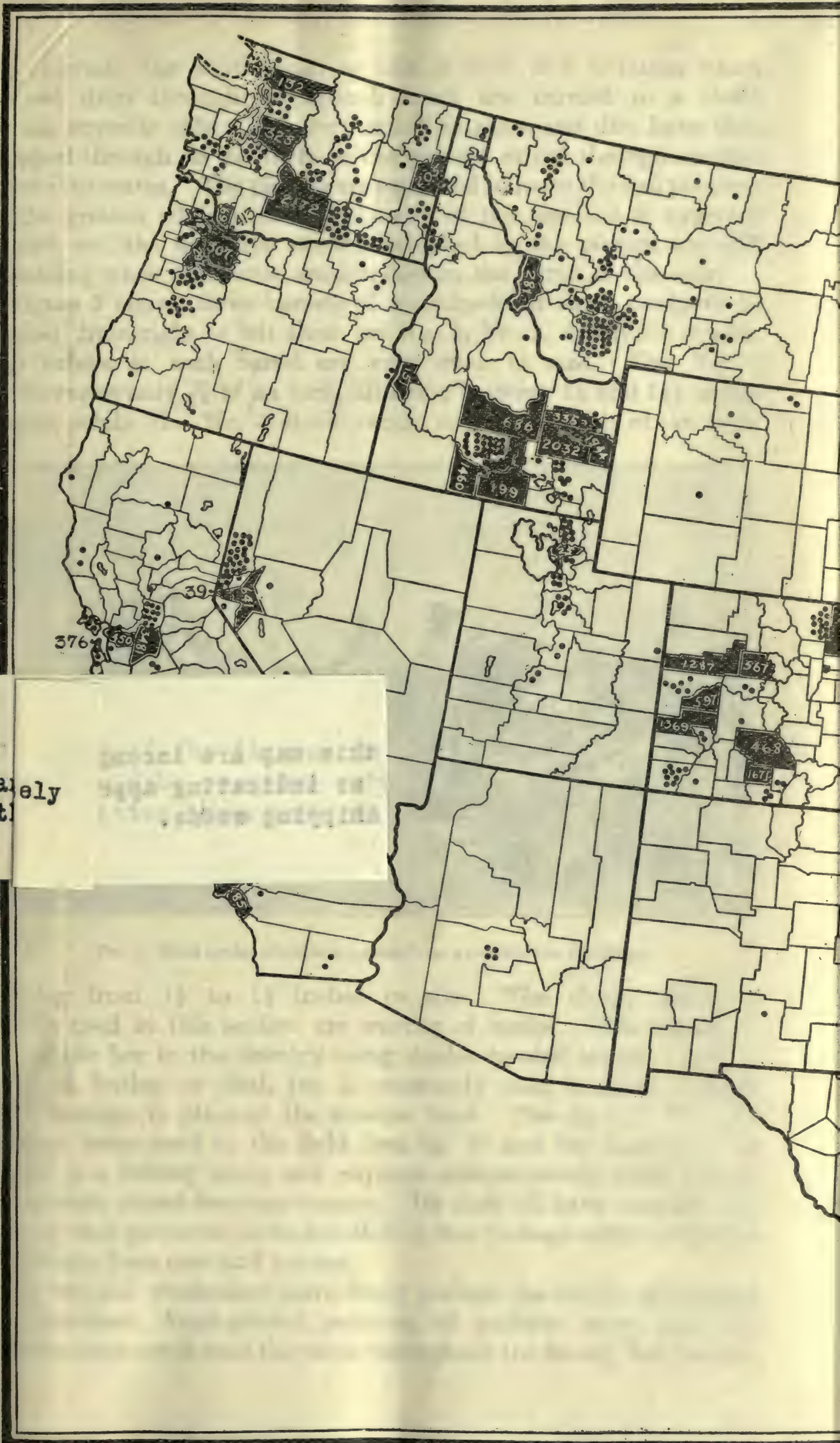

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FIG. 1.—Map showing carload potato shipments in 191

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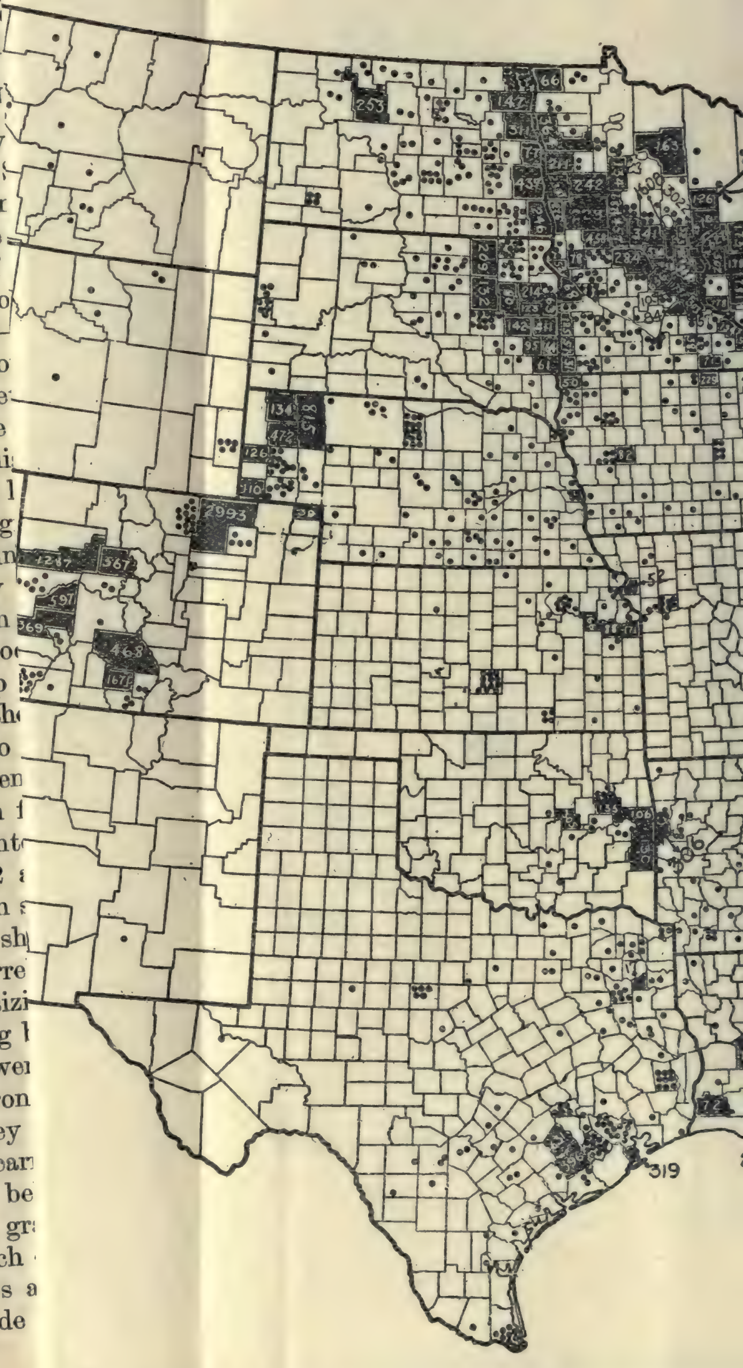
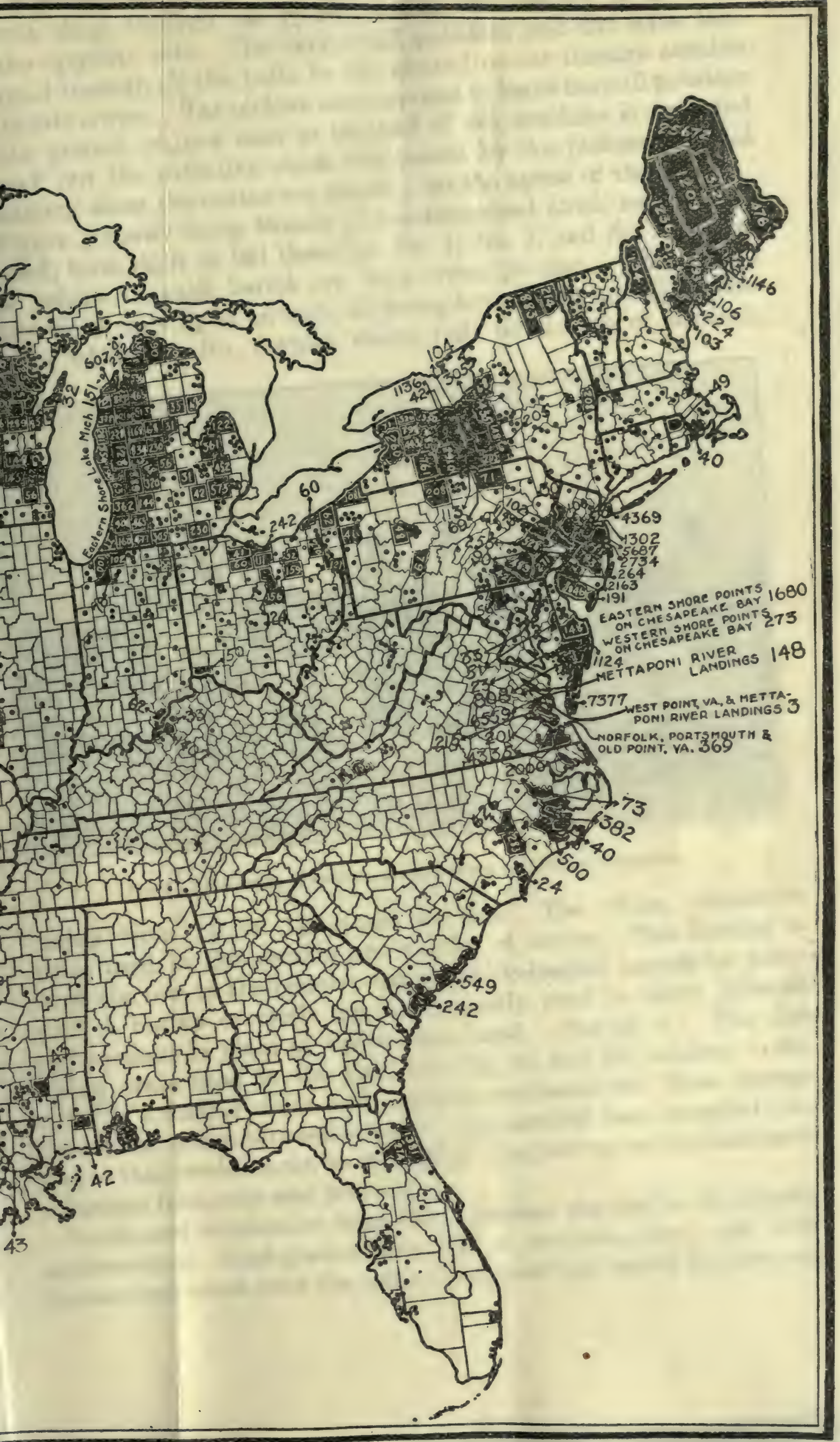


ato shipments in 1915. Each dot represents five carloads, or fraction thereof. The bla


Eastern Shore Lake Mich
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EASTERN SHORE POINTS ON CHESAPEAKE BAY 1680
WESTERN SHORE POINTS ON CHESAPEAKE BAY 273
1124
METTAPONI RIVER LANDINGS 148
7377
WEST POINT, VA., & METTAPONI RIVER LANDINGS 3
NORFOLK, PORTSMOUTH & OLD POINT, VA. 369
2000
73
1382
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500
24
549
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42
43
242
60
1136
42
104
305
205
507
151
32

resent the number of carloads indicated by the figures.

No. 3 grade, the third chain or belt is used and potatoes which do not drop through its 1¼-inch mesh are carried to a chute on the opposite side. The very small potatoes and dirt have then dropped through all the belts to the ground or out through another chute into crates. The pickers are supposed to leave the cull potatoes on the ground, while a man at the end of the machine is expected to pick out the defective stock overlooked by the pickers and still remaining when the crates are emptied on the apron of the sizer.

Figure 3 shows three barrels of machine-sized stock ready to be headed; from right to left these are No. 1, No. 2, and No. 3 grades. The tubers in each barrel are very even in size. The No. 2 grade varies only $\frac{5}{16}$ of an inch, all being between 1½ and 1$\frac{13}{16}$ inches in size, while the No. 3 stock varies only one-fourth of an inch, running from 1¼ to 1½ inches in size. The clean, attractive barrels used in this section are worthy of notice. This locality is one of the few in the country using double-headed barrels for potatoes. A burlap or cloth top is commonly used in other Atlantic coast sections in place of the wooden head. (See fig. 4.) The slat picking crate used in the field (see fig. 2) and for hauling to the grader is a folding crate and requires comparatively little storage space when stored between seasons. Its slats all have rounded corners, so that products can be handled in this package with a minimum of damage from cuts and bruises.

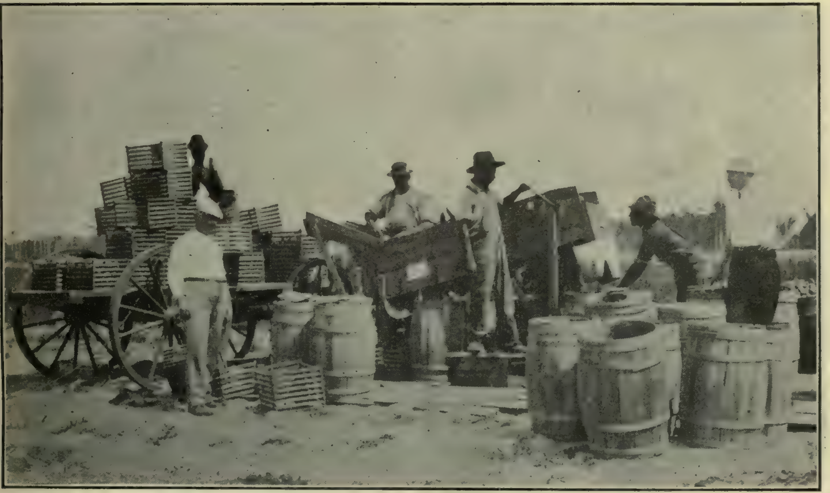

FIG. 2.—Field sorting of southern potatoes over a machine into three sizes.

Buyers and wholesalers have freely praised the results of shipping machine-sized, hand-graded potatoes of uniform sizes, not only because such stock runs the same throughout the barrel, but because after the potatoes have been handled in the crates and over the machines they are usually dry when they reach the container and the field dirt has been shaken or rubbed off, so that very little goes into the barrel. Growers state that although more teams are needed on account of hauling from the field to the machine, a greater acreage can be dug, sized, and loaded per day than when graded in the field because pickers can work faster and the potatoes are both sized and hand-graded over the machine more rapidly. In one packing house 900 barrels a day have been run over a power sizer, and it is stated that its daily capacity is from 1,000 to 1,200 barrels.

In handling this stock care must be exercised in digging in order that no potatoes shall be cut by the forks. Defective tubers should be left temporarily on the ground and not picked into crates, but when affected with any troublesome tuber disease they should later be picked up and removed from the field. The crates should never be filled above level full, for the potatoes might be mashed or cut when the over-full crates are stacked and hauled. Crates should be carefully and deliberately emptied on the machine, the belts should be fed evenly and never allowed to be overloaded. Best results cannot be obtained when the machines are made to run too fast. Barrels should be shaken down at least twice while they are being filled, so that they will still be full and tightly packed on reaching the market.

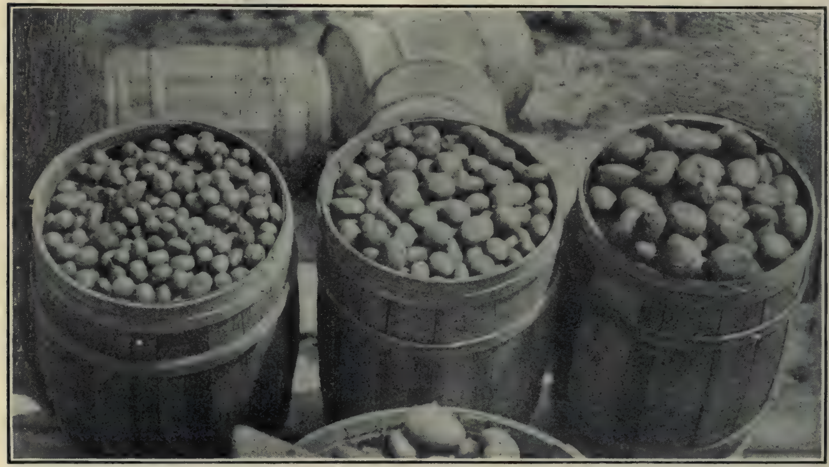

FIG. 3.—Three barrels of new potatoes sized over a machine, ready to head up. Note uniformity in size.

Notwithstanding the very large holdings of old potatoes all over the North in the spring of 1915 and an increased production of new potatoes from Florida, these new potatoes brought uniformly high prices. This is said to have been due partly to the excellent quality of the new stock, partly to the grading and packing, and partly to the fact that the distribution in the markets was good. Carloads were shipped to Panama and Alaska.

South Carolina.—In the South Carolina section where the Irish Cobbler is the chief variety grown, most of the potatoes are dug with a straight spading fork. In the Hastings section of Florida the negro help is paid by the day for its labor, but in the South Carolina section it is paid 10 cents a barrel for digging, picking, and packing the potatoes. No doubt the potatoes are not so carefully handled nor graded, because the diggers and pickers endeavor to complete as many barrels as possible each day.

A number of sizing machines have been shipped into this territory, but on account of the late rainy season in 1915 they were not given a fair trial. Two grades, No. 1 and No. 2, are marketed, but shippers state that through the lack of fixed standards for these grades and the growers' lack of care in grading, entirely too many small and defective potatoes are placed in the barrels.

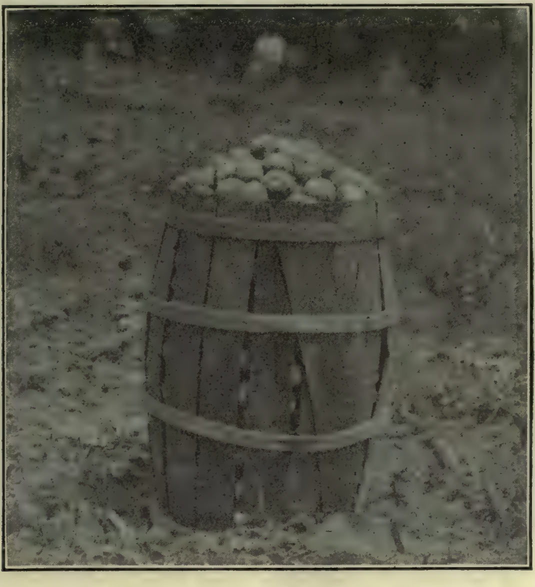

FIG. 4.—Early potatoes in veneer barrel ready for the burlap cover. Note the light, frail construction of the barrel.

One association manager states that he has been able to sell all of the potatoes loaded by his growers when he could guarantee their quality, but that many times he is forced to make consignments of carloads because the stock is not up to grade, or is ungraded.

Virginia.—The Irish Cobbler is the principal variety shipped from the heavy producing section of the Eastern Shore of Virginia, about one-half of the seed being secured in Maine, the other half being specially grown locally. Digging begins in this section about June 1. Nearly all growers plow out their potatoes, only a few using machine diggers. The potatoes are then scratched from the dirt by hand and picked into baskets, from which they are emptied into barrels (see fig. 5). The illustration shows two of these baskets, the smaller costing the grower about 25 cents and the larger 50 cents. It has been found very important in hot weather that potatoes shall not remain in the field in the hot sun, so in this section the best method seems to be to dig the potatoes late in the afternoon or evening and have the pickers in the field at daylight in order to get the cool potatoes into the barrels and haul them to the cars before the day becomes hot.

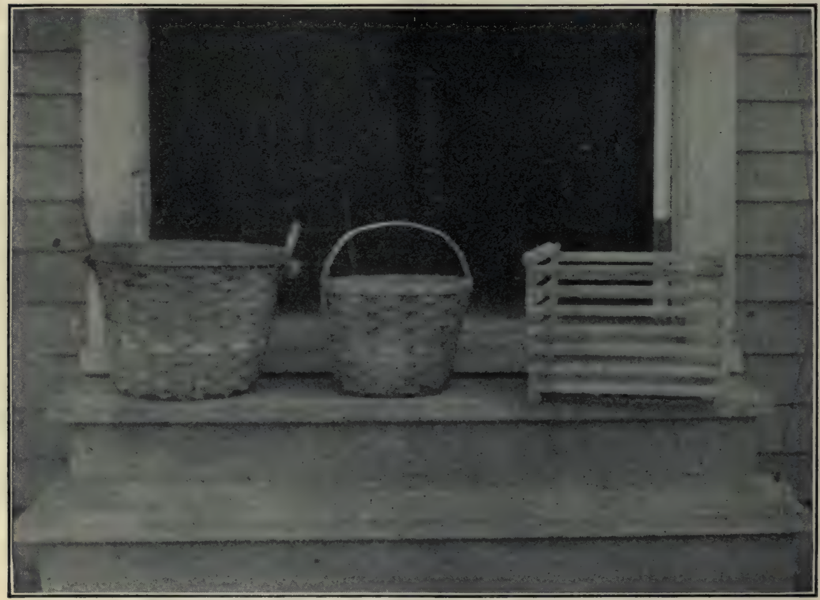

FIG. 5.—Large and small sized picking baskets, and a slat picking crate in which potatoes are picked and hauled to cars.

During the 1915 season several hundred carloads were shipped in bulk, an unusual method in this section, but on account of the extremely low prices growers resorted to this procedure to save the barrels and covers, costing 26¾ cents. One advantage to the buyer of potatoes loaded in bulk is that the defective stock shows up very plainly. These potatoes marketed in bulk were picked into bushel slat crates (see fig. 5), costing the grower 18 cents each. These crates were loaded on wagons and hauled direct from the field to the cars and then emptied (see fig. 6). It can readily be seen that this type of package is a very convenient and suitable receptacle for this purpose. Its rounded slats prevent cuts and bruises; it is handy, durable, and can be folded up and stored in a small space during the winter.

Pickers here are usually paid 10 cents per barrel or 3 cents per hamper when following the plow, but in 1915 the price was in some cases reduced to 8 cents per barrel and pickers following the digger were paid 2 cents per crate of 60 pounds. This reduced rate probably will not apply in normal seasons.

It is said that about 125 sizing machines, similar to those used in Florida (see fig. 2), were shipped into this section in 1915, but the extremely low prices prevailing for potatoes interfered somewhat with their general use.

The management of the growers' cooperative marketing organization which shipped over 10,000 carloads of potatoes from this section in 1915, strongly believes that proper grading and handling of the crop is of primary importance. Although this organization has become widely known for its dependable output, the management is not yet satisfied with results and is endeavoring and planning to standardize its shipments still further. An inspector is employed at each of about 44 loading stations maintained by the organization and a chief inspector looks after the work of all. These inspectors are held strictly responsible for the grade of shipments leaving their stations and each one realizes that his standing with the organization depends largely upon how many or how few cars inspected by him and shipped from his station are eventually rejected or are the cause of complaints on arrival in the markets.

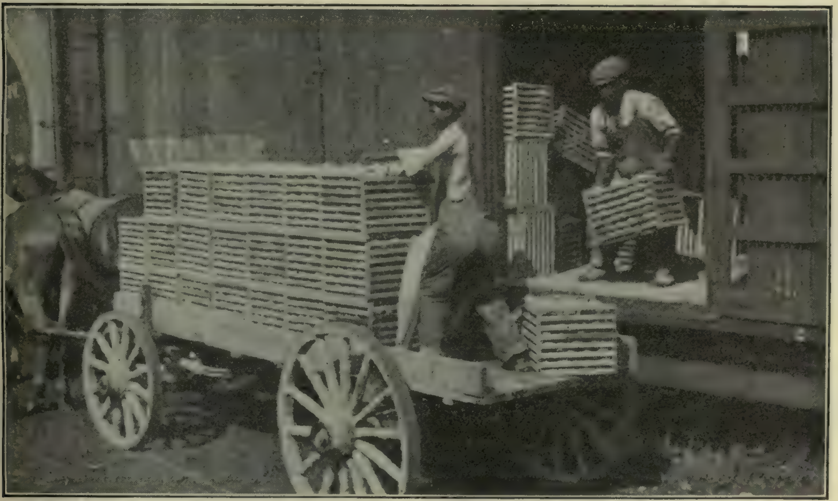

FIG. 6.—Method of loading and hauling potatoes in crates to cars for shipment in bulk.

The organization has established an enviable reputation on its first grade of potatoes. Each barrel of its best grade is shipped under a branded cover and when potatoes which do not come up to the requirements of the grade are received under such covers at the shipping stations the cover must be removed and a plain one substituted or the contents must be regraded, as nothing but first-grade stock is allowed to go out under this brand. This grade calls for stock about 2 inches in diameter. The two sizing belts on the grading machines shipped into this territory are of $1\frac{15}{16}$ and $1\frac{7}{16}$ inch mesh. The potatoes must be bright, free from second growth, disease, and other defects. Scabby, worm-eaten, or sunburned potatoes are barred. Stock which does not meet the requirements of the first grade is shipped in barrels bearing unbranded cloth or burlap covers. (See fig. 7.) All barrels must be well shaken down and well filled so that they will be full and present an attractive appearance on arrival on the market.

When a car is loaded by more than one grower, the association s representative marks the grower's initials on each barrel placed in the car, in order that the stock may be identified and traced if there is any question regarding the quality, either at shipping point or on the market. Frequently with potatoes marked in this manner an adjustment may be secured on a rejected car by making an allowance only on the potatoes placed in the car by one grower, while if the number of barrels in the lot is unknown, the allowance would probably have to be given on every barrel in the car, although perhaps only 15 or 20 barrels were loaded by the offending grower. The chief inspector seeks to have all growers who employ several pickers give each a number which must be marked on the outside of every barrel filled by him. This practice enables the inspector at the car door to do better work, because when he finds that one picker continues to do

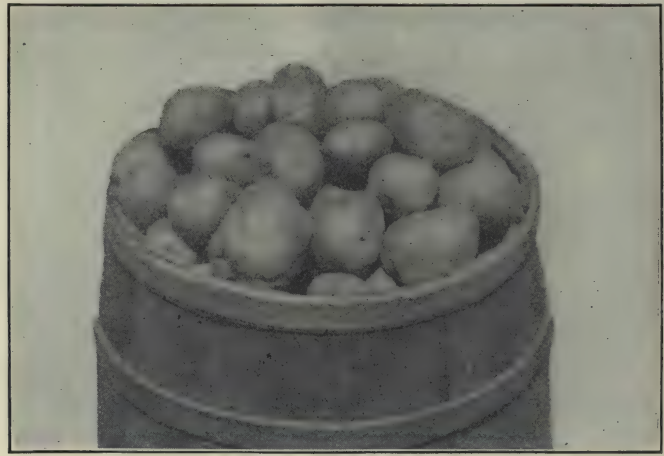

FIG. 7.—A well-filled barrel of fancy, clean, early Virginia potatoes ready for branded burlap cover. Note strong construction of barrel.

poor grading, the barrels bearing his number may be marked down to a lower grade, be sent back for regrading, or the picker may be be replaced.

The method of inspecting barreled potatoes is shown in figure 8. For this purpose one-half of a barrel is reinforced with extra hoops and a sufficient number of barrels from each grower's load is partially emptied into this half barrel for examination to enable the inspector accurately to judge his receipts. It can readily be seen that deception in packing is kept at a minimum by this method.

Between $30,000 and $40,000 a year is appropriated by the directors of this organization for its inspection service. In 1914 its growers were paid nearly $6,000,000 for the products marketed through this organization; in 1915, notwithstanding the very disastrous season caused by "glutted" or oversupplied markets, low prices, and an unusually heavy production of early potatoes at the time they were shipping, the percentage of cars consigned was less than usual, practically all of their shipments being sold outright. These facts indicate that their endeavors to maintain uniformly high grades must be in the right direction.

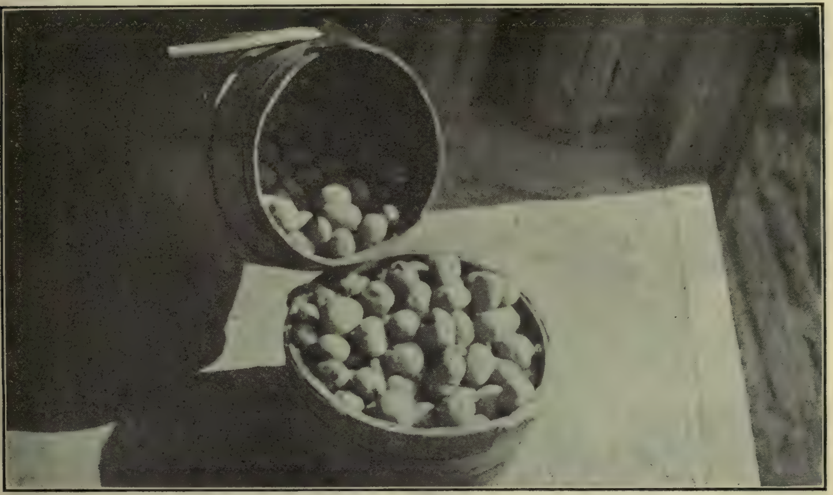

FIG. 8.—Barrel of potatoes in car doorway partially emptied into tub allowing inspector to make careful examination.

There are a number of other growers' organizations that market potatoes from Virginia, Maryland, Delaware, and New Jersey, most of them endeavoring to bring about better and more uniform grading. In at least one of these sections many grading machines have been bought. In most of the potato sections of these States a No. 1 and a No. 2 grade are recognized, but entirely too large a part of the crop moves out under the No. 1 grade. The result is that freight is paid on much defective or worthless stock mixed with the good potatoes. This stock, which it is frequently necessary to sort out after reaching the market should be taken out on the farm.

HANDLING NORTHERN LATE POTATOES.

The 12 heaviest late potato producing States of the North and West are Maine, New York, Michigan, Wisconsin, Minnesota, Pennsylvania, Ohio, Illinois, Iowa, Nebraska, Colorado, and Idaho.

DIGGING.

Digging usually is begun some time between the middle of August and the middle of September, and the bulk of the crop is dug and stored by about October 15 to escape the possibility of freezing weather.

Northern potatoes are dug by hand with fork, with the plow, and by means of the large two or four horse digging machines (see fig. 9) For large areas it is economical to use an elevator digger, of which there are several types. Some weigh as much as 1,000 pounds and are drawn by two, four, or six horses, according to the condition of the land. When conditions are favorable, the use of a digger is recommended as the work may be done more quickly and more economically. An elevator digger will turn out from 3 to 5 acres per day, depending upon the nature and condition of the ground. If a grower has only a small acreage planted to potatoes and is unable to purchase a digger himself, one may be bought cooperatively with his neighbors, the cost to each thereby being reduced, and most of the advantages of a privately owned machine secured.

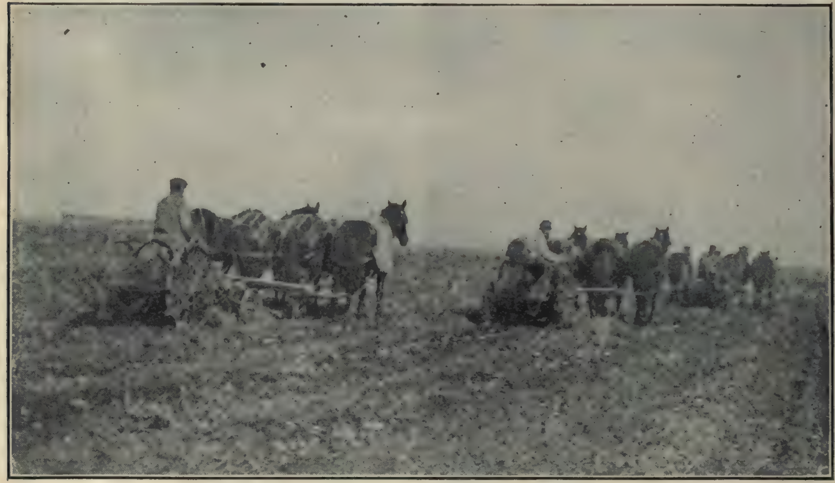

FIG. 9.—Digging scene on a large potato farm near Moorhead, Minn.

In the Red River Valley potato district of Minnesota mechanical diggers are used almost exclusively, while in Wisconsin forks as well as mechanical diggers are used. In the Upper Peninsula of Michigan a long-handled fork having five prongs, each about 14 inches long is used for nearly all digging. In some instances ordinary one-horse plows are used.

The heavy losses due to rough handling, cuts, bruises, and the consequent decay are not generally realized on the farm. A visit to the retail stores where many such unsalable potatoes are sorted out and lost would show growers one reason why the retailer must secure a seemingly large price over his first cost. Much of this waste can be directly attributed to improper methods employed in the use of machine diggers and to rough handling, and can be prevented to a great extent by the use of more care and less haste.

Some growers believe that by using a fork greater care can be exercised than with a plow or machine, the loss being reduced to a minimum, but this method of digging is so slow that it is not economical on large areas. Deep plowing with the machine and plow will help to reduce the number of cut potatoes.

PICKING.

In these regions potatoes are picked in the field almost exclusively by hand. Several types of combination digging and picking machines are on the market and a few are in use in the late-potato States. For successful use the grower must have ideal soil conditions and the buyers of these machines are expected by manufacturers to know if they have conditions which will warrant purchasing such machines. These machines not only dig the potatoes but deposit them either in crates or bushel piles windrowed across the field. Where soil conditions are suitable they should be labor savers.

Transient and local help, which sometimes includes boys and girls, is used where the crop is picked by hand. A day's picking ranges from one hundred to two hundred bushels, depending upon the ability of the worker. It requires on an average five persons to pick up after one digging machine. If the potatoes are to be graded in the field as gathered, the pickers should be thoroughly instructed before the digging begins, as to the requirements of the grades. The inclusion of a few diseased, cut, or defective potatoes is sufficient to discount an entire shipment, for its selling value is largely determined by the poorest in the lot rather than the best.

Potatoes are picked into the bushel wire basket (see fig. 10); the folding slat crate (see fig. 5); and a square bushel box. The wire basket is the most extensively used and in some places the potatoes are emptied from the baskets into field boxes which later are emptied into wagons for hauling to the car or warehouse. They are then handled one or more times with shovels or scoops. (See fig. 10.) In other places the filled wire baskets are emptied into sacks in the field and these are hauled half full to storage cellars, houses or the cars and there emptied. Hauling loose in a wagon from the field is a bad practice, whether to the car or storage house and is not recommended, as potatoes are seriously damaged by repeated handling, and such methods do not appear economical. (See fig. 11.)

From observations and investigations made by representatives of the Department of Agriculture a crate with rounded slats holding about a bushel is recommended instead of a picking basket or box. Potatoes picked in this crate can be loaded on a field wagon and hauled to the storage house or car without any dumping or rehandling (see fig. 6).

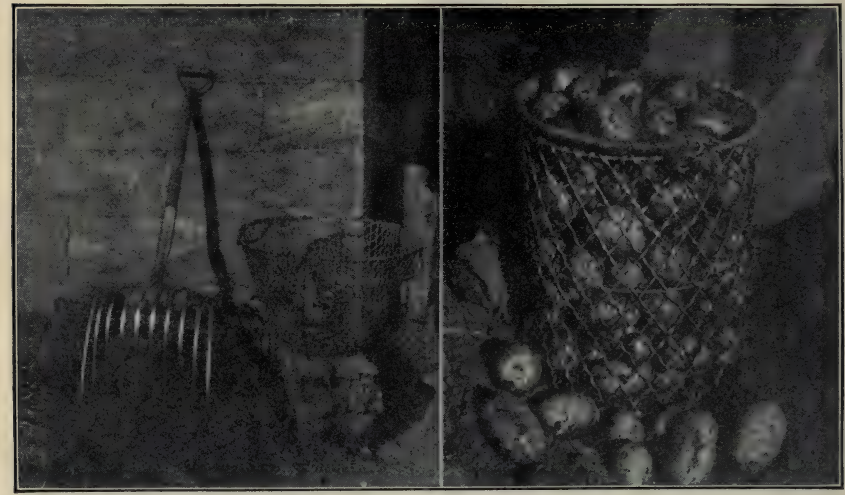

FIG. 10.—Two types of wire picking baskets, and a fork or scoop for forking potatoes.

SIZING.

Sorting or sizing machines of various types are used in many districts, some operated by hand and others by gasoline or electric motor. The object of these machines is to sort the potatoes for size, and eliminate the dirt, but it is believed that too many growers and shippers leave the grading for quality, as well as the sorting for size to the machine. If properly managed, it will size the stock satisfactorily but every grower should do his part by carefully removing by hand all defective potatoes.

Potato sorting for size as accomplished over machines is more accurate, satisfactory, and rapid, and by many is considered more economical than the old method of hand-and-eye sorting. The uniformity of size obtained enables the seller definitely to recommend and guarantee the size of his potatoes. Any sizing machine used should be so built as to allow a large apron and a long belt or other sizing device (see fig. 2). The large apron or table on the machine is necessary in order that the operator or sorter may have ample opportunity to remove all defective stock before the potatoes go on the belt or other sizing device. A sufficiently long machine or belt is essential in order that the tubers will have sufficient distance to travel so that they will be properly sized before leaving the machine.

To obtain the most economical results with mechanical sizers of any description a continuous supply of potatoes should be on hand so that the machine and men tending it will be kept constantly employed. The drop from the machine into the shipping packages or other containers should not be a long one and the potatoes should be safeguarded against bruises or cuts not only in dropping from the machine but during all the time they are in or on it. Every precaution should be taken to avoid their coming in contact with sharp projections of any kind.

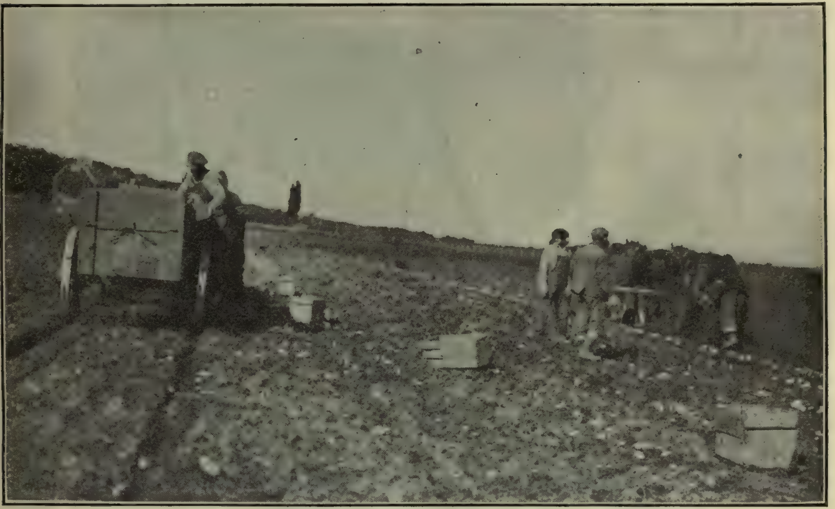

FIG. 11—Four-horse diggers, wire picking baskets, and field boxes; bulk loading into wagon.

The hand sorters are of various types. The type which is in general use in the Moorhead district of Minnesota, sizes the potatoes over rods spaced an inch and five-eighths and an inch and one-quarter apart. It is portable, light, and may be used either in the field or the warehouse. The type of machine already described (see fig. 2), used in Florida and other Atlantic coast sections, is also used in Maine, New York, and the Northern Central States. Another (see fig. 12) designed especially for field sorting but also adapted for warehouse and cellar sorting is about 5 feet high, 7 feet long, and 33 inches wide over all. The upper screen is about 3½ inches above the lower or dirt screen. Sizing is accomplished by swinging the hoppers forward and backward by the hand bar at the top of the rear end of the hopper. The larger potatoes come off at the right over the top screen and the smaller potatoes come off at the left, over the lower screen.

In another type of sorter adaptable for warehouses, cellars, loading stations or cars, the potatoes are placed in the lower hopper and are sized as they pass upward on an endless flexible screen. The small potatoes, dropping through, pass out at the side, free from dirt, over a stationary slanting dirt screen. This machine is somewhat similar to the one shown in figure 2.

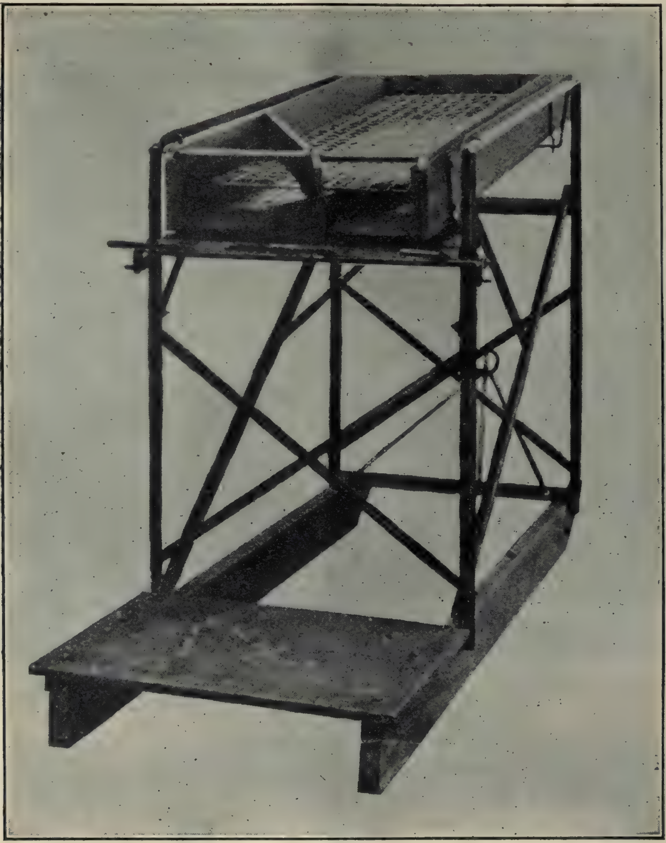

FIG. 12.—One style of sizing machine for field or warehouse use.

These descriptions are furnished only to give a general idea of machine sizers since there are a number of other types of potato sorters on the market.

A larger percentage of the commercial crop of potatoes should be sorted for size by machinery, in the field or at the warehouse, to eliminate the undersized stock. If dug during wet weather, machine sizing will separate much of the dirt from the potatoes. Complaint has been heard from buyers regarding the dirt frequently found in shipments. They claim they do not receive sufficient allowance for dirt when sorters are not used and that a general use of sorters would tend to alleviate this trouble.

GRADING.

It seems quite unnecessary to say that no machine has been made which will grade potatoes as to quality. The mechanical sizer simply sorts as to size, and the stock must be further graded by hand to eliminate potatoes affected by sun burn, dry-rot, scab, frost, cuts, or other defects. Investigations in nearly any wholesale market, of the manner in which potatoes are prepared for market by the shipper, will usually convince the most skeptical that there is great need of improvement. On every side may be seen quantities which must be sorted before they can be sold or which must be sold ungraded at reduced prices. Large and small, smooth and scabby or otherwise defective potatoes frequently are all shipped together.

The amount of money lost to growers, dealers, and consumers each year through the shipment of ungraded or poorly graded potatoes can not be estimated, but that it is very large and mostly unnecessary must be admitted. In many markets scores of men may be seen in cars sorting potatoes. Large quantities that are frosted, decayed, badly cut, bruised, diseased or otherwise defective are thrown away. Usually these are the grower's losses and besides losing the invoice value of the defective stock culled out of these cars, he is also paying about twice as much for the labor as though he had graded the potatoes on the farm. The railroad receives the only full returns on such cars, for their charges are based on the quantity of potatoes hauled and not on the quality.

Quantities of cull potatoes sorted out of supplies sold to consumers may also be found in most retail stores that handle vegetables. Notwithstanding these losses by wholesalers and retailers, much undesirable stock is passed on to the housewife. This is a common complaint among consumers and they frequently ask why they do not receive better potatoes, stating that they do not buy and use as many potatoes as they would if good ones were always received.

It is found in all sections that the potatoes loaded into cars and shipped from the field at digging time, usually receive less care in sorting for size and grade than those shipped later in the season from warehouses or cellars. This is partly due to the rush to get the crop harvested and partly to carelessness. During some seasons hundreds of carloads are forwarded which, when loaded, are known to have been more or less frosted or frozen in the ground, or sometimes after digging or loading. When a grower or shipper knowingly loads such stock he invites disaster, rejections and losses. During the fall of 1915, hundreds of cars containing blighted, frost damaged, or otherwise diseased and decaying potatoes were shipped. A broker in one city in the Middle West stated that in the previous three weeks 150 cars of potatoes had been rejected on that market on account of poor condition. As this report concerned only one medium-sized market, for just three weeks, the total number rejected for this reason on all markets must have caused serious losses. These potatoes, no doubt, were shipped direct from the field.

Many of the cars of potatoes received on the markets, both bulk and sacked stock, contain only sufficient frosted or otherwise defective tubers to show a few "rots," but the sacks or potatoes near them become wet and it is then necessary to sort the entire car at heavy expense. Figure 13 shows three barrels of "rots" taken from one end of a car of Maine bulk potatoes.[1] While the actual quantity of potatoes lost was only about 20 bushels altogether, the freight on these and the labor charges for sorting the entire car at destination made a large bill for the grower to pay.

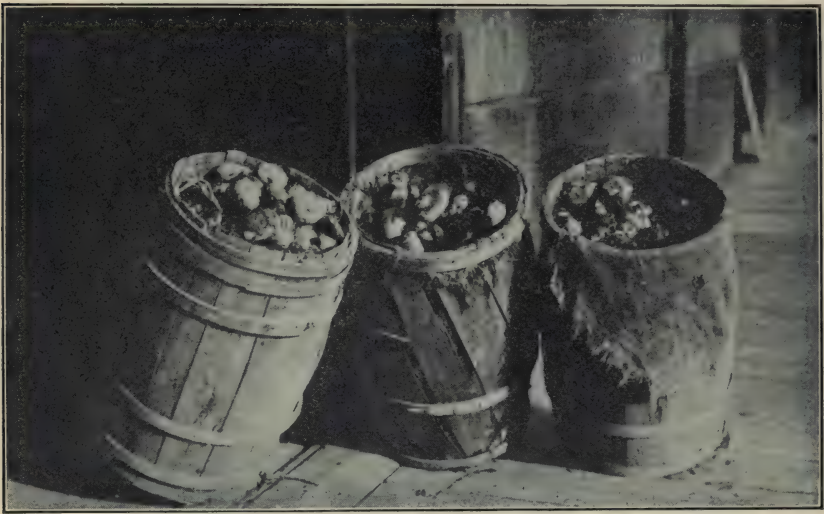

FIG. 13.—Three barrels of decayed potatoes sorted from one end of a car of bulk stock. These potatoes caused much more stock to be wet and unattractive.

If all growers could have enough storage space so that their crop, when partly frosted or otherwise defective, could be held after digging until the damaged potatoes could all be detected and sorted out, instead of dumping them on the market immediately after digging, all concerned in marketing them would realize more money, as a rule. One dealer stated recently that in his opinion sentiment has as much to do with the potato market at times as have supply and demand. It is certain that when markets have been flooded for weeks with frosted stock or stock which shows more or less decay; every one concerned in the marketing of this crop becomes disgusted and the result is a "sick," "draggy" market on which every buyer expects to receive stock at a discount and waits until he does get it at a reduced price. Buyers are then afraid to pay the better price for good potatoes on account of the low price prevailing on "off" stock.

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[1] Further data concerning the loss encountered in shipping such potatoes is shown in: More, C. T., and Branch, G. V.—Marketing Maine Potatoes, U. S. Dept. of Agriculture, Office of the Secretary, Circular No. 48, 1915.

The larger part of the commercial potato crop is stored by growers or dealers and since this must be rehandled and most of it sorted to make certain no decayed stock is shipped, little extra effort would be necessary to grade the potatoes according to fixed standards. The results would more than justify the slight extra expense. The sorting table or "rack" as it is called (see fig. 14), is used extensively in Maine and some other districts to sort and grade potatoes when they are shipped from storage. They are emptied on the high end of the rack and as sorted by hand run out at the lower, narrow end into barrels or bags.

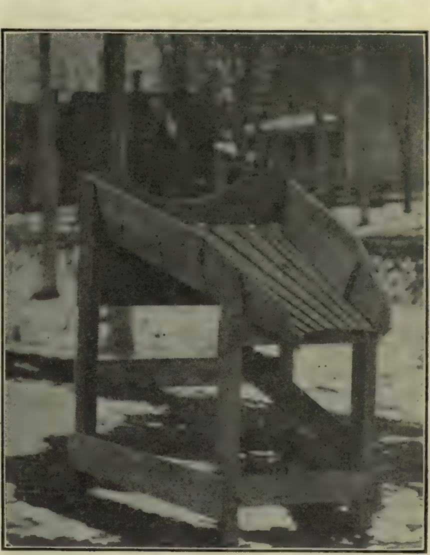

FIG. 14.—Rack or sorting table for grading potatoes by hand.

Wholesale dealers claim that potatoes always should be bought from producers on their merits but that at present in many places practically all grades are bought at the same price. This neither penalizes the careless grower nor rewards the progressive; on the contrary it rewards slack methods and penalizes careful grading. Some dealers freely admit that in their opinion the dealers and all other buyers at points of production are largely responsible for present conditions because they have not given growers sufficient encouragement to grade carefully by always discriminating in price in favor of fancy stock. Competition in buying as well as in selling is very keen. Each buyer or dealer desires to do as large a volume of business as possible, and just as long as the potatoes he purchases can all be resold, everything offered him by growers will be bought almost regardless of grade. If one buyer at loading point refuses a load or a car on account of quality, usually there is another buyer ready to take it at the same price. Inspection by buyers at loading point is not as close and careful as it should be and too much is taken for granted. More care at this point would prevent many later rejections.

A large part of the grading and nearly all of the sizing in northern sections now is done by the local dealers or warehousemen and by the distributors' representatives at their warehouses or loading stations. Of course, the grower is relieved of this extra labor, but he must pay for the buyer's expense in accomplishing this work by taking a lower price for his product and sometimes losing the feeding value of the culls besides.

It should be remembered also that when growers leave the grading to the warehouseman they put themselves just that much farther away from direct dealing with the independent cash buyer or from direct sales to dealers in the cities. However, if the grower lacks the willingness to grade his potatoes effectively it is as well that the warehouseman or local dealer should do it.

NEED OF STANDARDIZATION.

The impression prevails that the greatest problem facing the fruit and vegetable-growing industry is that of marketing, and the standardization of these products is acknowledged to be one of the most important phases of that problem. Only a start has been made in this country looking toward the standardization of agricultural products. Standards for fruits and vegetables are difficult to establish because of their perishable nature, the wide difference in varieties, and the varying conditions under which they are grown. Standardization is generally taken to mean the establishment of suitable standards of quality which will include such regulations concerning the digging, handling, sorting, sizing, and packing, as will insure a uniform, standard product of high quality. It should be extended to include the shipping containers used.

It is equally important, however, that standardization be applied to the production of this crop. An effort is being made in many States to standardize the varieties grown. This movement aims to confine the planting in each section to a very few varieties which have been proven the best for that locality. An endeavor is then made to plant only seed true to name and of the best selection. The result of such methods is to standardize these few varieties of pure strains and eventually make the section widely known as producing certain varieties to a high degree of perfection and in large quantities.

There is a special need of standardization of potatoes, because they occupy such an important place on the tables of most families. Wholesalers and retailers usually aim to handle potatoes on as narrow a margin of profit and expense as possible because they are such a bulky, comparatively low priced and widely used commodity, but in order to be handled on the narrowest margins the product must be standardized so that expense and risk in handling, waste, and loss, are reduced to a minimum. The demand at this time is for the establishment of uniform grades for potatoes which shall be accepted as the basis for all trading in this crop throughout the country. Such nationally accepted grades would give buyer and seller a foundation on which to deal with a better understanding and mutual confidence.

To-day each grower or community usually grades according to local custom, if at all, and, as a result, wholesale dealers have very little confidence in the quality of their purchases until they are carefully inspected. For this reason these firms prefer to buy from large shippers, or farmers' cooperative marketing agencies, that have built up a reputation for shipping only uniformly high-grade products.

The manager of a growers' association that markets truck crops and small fruits stated recently that they had gone out of their regular line during the past season and marketed a large crop of barreled apples. When asked if these were packed under the State apple-grading law and also regarding the success of this law and grades, he said: "It certainly has been the means of great improvement, for I sold that crop of apples without seeing or inspecting them, to a distant buyer who had no means of inspection until the fruit arrived, all on the statement that the fruit was packed under these established State grades, and every car was accepted on arrival." This is a concrete example of what is being accomplished on a crop which is far more perishable than potatoes and which requires more careful handling and packing.

Organizations of growers and shippers have advocated National standards and grades for potatoes, which the various States might also establish, in order to obtain fixed uniform standards. The States could compel the use of such grades whenever any grades were used, thus forcing growers, buyers, and dealers on the market to use and respect those grades. All rejections and disputes will be much easier to adjust when such a basis is established.

The diversity in varieties and shapes and the difference between the early and late crops must be recognized, and it is possible that variations in standards will be found necessary.

MARKET PREFERENCES.

It can not be said that market demands are unreasonable. The standards demanded or preferred by the wholesale dealer are not to be feared. A few large consumers, such as railroad dining-car departments, hotels, and clubs, are willing to pay an extra price in order to obtain specially selected, practically perfect stock, such as is shown in figure 15. It is said that at times the offerings of potatoes of this grade are not sufficient to meet the demand.

Most growers, however, are more interested in the demands of the average consumer. This great class of buyers asks only for a grade of potatoes which is sound, free from culls or waste stock, and of good average size. The important point is that this class of consumers does not like to pay retail prices for defective, diseased potatoes or any commodity on which there is an unnecessary waste in preparation for the table. Deep-eyed potatoes are not so desirable as the shallow-eyed, smooth varieties. Dealers state that in addition to these two classes of buyers there is a sufficient outlet among other classes of trade for a good second grade of potatoes.

It is a mistake, then, for growers or shippers to force ungraded or poorly graded potatoes on the second great class of buyers, the average consumer who uses the larger portion of the crop, for these potatoes do not meet the demand and will seldom return the grower as large a profit as will well-graded stock.

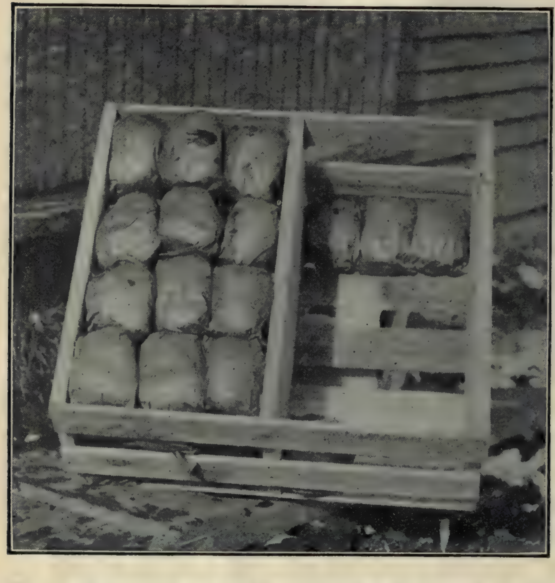

Fig. 15.—Selected, nearly perfect, uniform-sized, wrapped baking potatoes. Shipped in about 100-pound crates.

REQUISITES OF STANDARD COMMERCIAL GRADES.

The investigations conducted have not proceeded to a point where it is deemed wise to recommend definite grades for potatoes, but the need and value of such standards is generally recognized. It is believed that with relatively little trouble and expense needed improvements can be made and better results in marketing realized. The suggestions that follow, concerning requisites of standard commercial grades, are given for this reason and in order to assist growers, shippers, associations, or others now interested in the standardization of this crop.

From the investigations conducted up to this time and from a consideration of present commercial practices, it would appear that only two regular commercial grades would be necessary for the large commercial potato movement: No. 1 and No. 2 grades. In addition a "Special" or "Extra Fancy" grade of large potatoes might be provided, for the dining car and hotel trade. Potatoes for this special grade should be of uniform size, from 10 ounces to 1 or 2 pounds in weight, smooth, clean, and free from all defects. Potatoes of this grade, when crated, are usually wrapped. (See fig. 15.)

Fruits and vegetables sell largely upon their appearance, therefore the specifications for the No. 1 grade should be drawn to make it as good and attractive in appearance as is reasonable and practicable. These specifications should practically eliminate potatoes damaged by frost, sunburn, blight, common scab, dry rot, decay, second growth, cuts, bruises, or dirt, and also undersized or coarse stock. The minimum and maximum sizes for both No. 1 and No. 2 grades are still a subject for careful investigation, discussion, and demonstration. However, a minimum of about 2 inches is maintained in a number of early or "new" potato sections, and the commonly discussed minimum for this grade is from 1¾ to 2 inches. The minimum diameter for a long variety should probably be a little smaller than for a round one. Since it is practically impossible in grading any perishable products commercially to secure a perfect grade, reasonable tolerances should be allowed. The No. 1 grade should be packed in new, clean sacks or barrels, each to contain one variety only and to be well filled and securely sewed or covered.

Most growers and shippers appear to be prejudiced against marking or selling any product as No. 2, or second grade. This feeling should not prevail, for it seems certain that when a crop is properly sorted and all grades sold strictly on their merits, the average price obtained will be higher than for ungraded or poorly graded stock.

All growers should aim to produce as large a proportion of potatoes of No. 1 quality as possible, and if the crop is all of first grade it should be so marked, but some persons apparently wish to continue the practice of making only one grade or of making the first grade include entirely too large a part of the crop, in fact nearly all of it, when the crop as a whole falls far short of first grade. When market demands are considered it can hardly be supposed that such grading would accomplish the results desired. Such a grade would be neither as good nor as attractive as it is possible and practicable to make it, because there are in most crops many slightly imperfect, undersized, or coarse potatoes which if removed would leave a strictly first-class grade and yet these imperfect potatoes of themselves would constitute a marketable No. 2 grade. It is to be remembered also that very frequently a grower's crop from some cause—weather, soil, season, or seed—runs under average size, or in some other way contains so large a percentage of stock not of No. 1 grade that it seems best to market the entire crop as No. 2 grade. The No. 2 grade should include no stock which is not of desirable quality both for market and for table use and should be of fair average size. While broad enough to include a reasonable amount of imperfections not allowed in the No. 1 grade, such as potatoes showing a reasonable percentage of second growth, cuts, or common scab, this grade should not contain all that is left when the No. 1 grade is taken out, for the culls should be kept on the farm. The minimum size possibly should be as much as one-fourth to three-eighths of an inch lower than for No. 1 grade. Every sack, barrel, or other package containing potatoes of this grade should be plainly marked "No. 2 grade."

In order to eliminate the deception sometimes practiced in the past, no facing or topping with the best or largest potatoes should be allowed in barrels, sacks, or other containers. The average of the potatoes in the face of any container should represent fairly the average quality and size of the entire contents of the package.

If further investigations show that it is necessary to have one standard for northern or "late" potatoes and another for southern or "early" potatoes, that may be arranged. However, at this time the standards here discussed seem suitable for both the northern and southern crops. In devising standards for potatoes both the preferences of the trade and the consumer throughout the country and the needs of the grower and his crop as produced in various sections must be harmonized. The grades must be neither impracticable nor unfair to the growers, dealers, or consumers.

IMPROVEMENT THROUGH COOPERATIVE ORGANIZATIONS.

In most producing sections it is found very difficult, if not impossible, to secure any considerable voluntary inprovement in the grading and handling of products except through the endeavors of cooperative marketing organizations. By reason of a lack of knowledge of market requirements, carelessness, or a desire to force the market to take such stock as it suits his convenience to ship, the grower has failed to a large extent to make any headway in the standardization of the crop. Although this lack of standardization is often the cause of glutted or draggy markets it is everywhere found extremely difficult to induce the individual grower to prepare his crop for market properly. There are numerous benefits to be gained by growers shipping their potatoes through a strong cooperative marketing organization and this has been demonstrated to be the most successful method of securing a uniform grade of perishable products, properly packed in standard packages. Farmers' cooperative marketing organizations, or strong private shipping firms supply the major part of the standardized fruits and vegetables found on the markets at this time. Many of these organizations and private agencies may be found in Florida, California, the Northwest and other localities. Many of them have found it necessary, in order to build up a profitable business and establish a reputation on the market for shipping products of high quality, to establish their own association, or private packing plants, in which the products delivered by the growers in bulk may be graded and packed by skilled workers.

Attention is called to the description of the handling and inspection methods of a potato association in Virginia, page 7. Another organization in Idaho is meeting with success in its grading, but an unusual system is in use. A part of the crop is sorted into grades according to weight, four to six ounce grades, six to eight ounce, eight to twelve, twelve to sixteen, sixteen to twenty, and from twenty ounces up. At principal loading stations power graders have been installed. A chain elevator carries the potatoes from a hopper to a long table. Here pickers remove singly and by hand each desirable potato from the conveyer to another chain conveyer which carries one potato in each compartment, to the end of the table where they are automatically sized according to weight. The potatoes are then boxed or sacked according to the grades already mentioned.

In this locality it has been found impossible to get some of the growers to eliminate enough of the defective potatoes to make a proper commercial grade. Therefore, community or association grading warehouses were found an absolute necessity, and were used for sorting out their usual commercial grades before this more exacting system was installed.

A number of other cooperative potato marketing agencies in other States, some quite successful, might also be cited. Cooperation in marketing can not reach its highest degree of success unless it is supported heartily by all the growers.

CONTAINERS.[1]

Potatoes should be packed in new, clean containers, of uniform size. The use of second-hand sacks, barrels or other packages, should be discouraged. It is important that the containers used for every farm crop shall be, first, sufficiently strong and durable, and then attractive; otherwise the profitable marketing of the crop may be handicapped. Nearly all farm products must be transported over long distances and after they reach the large market they may be reshipped and rehandled many times, so that only strong packages which will stand this handling should be used. If it is necessary to use second-hand containers, only those that are clean and in good repair should be chosen. The attractiveness of the package as well as the stock, has much to do with the price which will be realized, and broken, or dirty barrels, crates, or hampers or rotten, ragged, dirty sacks are not attractive and will not transport the contents safely to market.

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[1] For a description of crates and requirements for exporting potatoes to South America see Commerce Reports, No. 212, Sept. 10, 1915, page 1236—"Developing Trade in Potatoes with South America," by Clarence W. Moomaw.

No standard container for the shipment of potatoes has been established by law, but the Federal standard barrel act fixes the capacity of the barrel commonly used for potatoes. There are now a number of types and sizes of containers used for the shipment of potatoes in different parts of the country. In California the lug box and the burlap bag holding 100 to 120 pounds are used. Burlap bags varying in size from 100 to 120 pounds are used in practically all sections west of the Mississippi River; an 85 to 90 pound sack is used in Mississippi. In the Moorhead, Minn., district the 2-bushel sack is used almost exclusively. In other sections of Minnesota, Wisconsin, Michigan, New York, and Maine many potatoes are shipped in bulk. Bags holding 150 pounds are also used in Minnesota, Wisconsin, and Michigan, while in New York and Maine bags holding 150 to 165 and 180 pounds are used. In the past veneer barrels and wooden stave barrels holding 10, 11, and sometimes 12 pecks, or 150, 165, and 180 pounds have been used in Maine and along the Atlantic Seaboard (see figs. 2, 4, and 13). Virginia, North and South Carolina, and Florida have shipped nearly all of their crop in these 10 and 11 peck barrels. Complaint is made that machine-made veneer staves or plaited veneer barrels used in South Carolina and some other sections (see fig. 4) are not satisfactory as containers for potatoes. They seem especially unsuited for shipping to western markets, the heavier stave barrel used in Virginia being preferred because too many of the lighter ones get crushed or go to pieces in the cars or before they have passed through the trade channels to the retailer.

The act of March 4, 1915 (38 Stat., 1186), commonly known as the standard barrel act, among other things, provides for a standard barrel of the following dimensions: Length of stave, 28½ inches; diameter of heads, 17⅛ inches; distance between heads, 26 inches; circumference of bulge, 64 inches, outside measurement; and the thickness of staves not greater than four-tenths of an inch. The capacity of this barrel is 7,056 cubic inches. (This capacity is a little more than 3 bushels.) In most sections of the country the standard barrel has already been adopted in anticipation of the requirements of the law. This act is administered by the Department of Commerce through the Director of the Bureau of Standards. Requests for information in regard to its interpretation and enforcement should be addressed to that department.

Early new potatoes are shipped from some parts of Florida and some other Southern States in bushel hampers. Only a very small percentage of the crop is shipped in this way. The railroads make strong objections to this package, pointing out that it is not of sufficiently strong construction to be a safe container for such articles as potatoes, cucumbers, and squash, and the condition of many shipments examined in the markets proves the justice of their contention. When hampers are used a particular method should be observed in loading as described on page 29. Crates and boxes are usual for the "Extra Fancy" or "Special" grade of potatoes prepared for dining cars, hotels, and restaurants. These are mostly of about 45 to 50 and 100 pounds capacity. (See fig. 15.) A slat crate containing about a bushel is used in parts of Mississippi for new potatoes.

The use of containers of so many types and sizes for potatoes seems entirely unnecessary. It causes confusion in the markets and makes the quoting of market prices more difficult. The cloth-top barrels used extensively in the East are not an attractive package, and as sometimes handled and loaded in cars are frequently the cause of losses to shippers. The veneer barrel has been referred to previously as an unsatisfactory package for potatoes. On account of their weight it is usually necessary to employ two men to load and handle potatoes in barrels or the large 10, 11, and 12 peck sacks. In some markets men may be seen handling these large sacks with hooks similar to hay hooks. This practice can not be too severely condemned, as the hooks are certain to injure the potatoes in the bags.

Investigators of the Department of Agriculture have made careful inquiries among shippers, associations, and dealers in the markets to learn the general sentiment concerning these packages and a standard container to replace them. While there are a few good reasons for the retention of some of the packages now in use, there is a very general feeling that a burlap bag holding about 2 bushels, or 120 pounds, is the most satisfactory package now in use and that it would be feasible and desirable to replace the larger bags and the barrel with this container. Some doubt is expressed as to the advisability of shipping in sacks the early immature potatoes that now move in barrels, on account of the likelihood of their becoming skinned and bruised, but it is to be remembered that nearly all of the early potatoes grown in California and all of those grown in Texas, Oklahoma, Louisiana, and Kansas are successfully shipped in sacks holding about 120 pounds. Potatoes in that package are easy to handle and load safely and well in cars. It has proven a satisfactory container.

A few experiments have been made in preparing potatoes for market in smaller containers which, after passing through the usual trade channels, will eventually reach the consumer in the original unbroken package. Cardboard or similar containers holding from 10 to 20 pounds have been used. One holding an even peck and bearing neat advertising on each side has been noted. It appears certain that a profitable trade in uniform, fancy, graded potatoes in such packages could be established in most cities through enterprising retailers. The principal requirements seem to be well-graded stock, possibly each package containing only potatoes of one size, as from 6 to 8 or 8 to 10 ounces; a continuous supply; wholesale and retail dealers willing to make an effort to introduce such a package and push it; and lastly, an article at a fair price.

BRANDS.

A brand is a distinctive identification mark and its use is a very effective advertising medium. Several large potato-shipping associations have adopted brands which have become well known, and these have doubtless been of value in selling their output when the grade has been kept up to standard, so that critical buyers might depend upon always securing the same quality.

Most of the box-apple shippers of the West and the orange shippers of California and Florida have adopted brands and labels. Their results have shown that fruit shipped in this manner sells more readily and generally brings more money. Branded material or sacks should not be loaned or sold to neighboring farmers or shippers who may not grade their stock. The use of a brand is recommended only when a shipper intends to establish and maintain a reputation for the quality of his potatoes, for if the grade and quality are not sustained the purpose for which the brand was intended is defeated.

MARKING PACKAGES OF POTATOES TO SHOW QUANTITY OF CONTENTS.

The act of March 3, 1915 (37 Stat., 732), commonly known as the net weight amendment to the Federal food and drugs act, provides in substance that an article of food shall be deemed to be misbranded if it be in package form and the quantity of the contents be not plainly and conspicuously marked on the outside in terms of weight, measure, or numerical count.

All articles of food, including potatoes, shipped in interstate or foreign commerce, or offered for sale in the District of Columbia or Territories of the United States, are subject to the provisions of the net weight amendment, if in package form. This act is administered by the Bureau of Chemistry of the Department of Agriculture. All requests for interpretations of the law and for instructions with regard to marking packages should be addressed to the Chief of the Bureau of Chemistry, Department of Agriculture, Washington, D. C.

LOADING CARS.

Experience in the barrel-apple States has demonstrated the best method of loading apples packed in double-headed barrels. The same method has proven safest in Florida for potatoes in similar barrels. Figure 16 shows this method. The barrels are lying down across the car. Three placed together end to end will extend across the car except for a space of about a foot and a half. This space should be left first on one side and then on the other; that is, if the first three barrels on the bottom are loaded from the right of the car, the next row above should start from the left. This will bring the bulges of the barrels in the second row between the bulges of those below, which will make the load ride better and relieve the pressure on the bulges of the barrels. As each successive row is placed on the bottom of the car the barrels should be "chocked" so that the loading will be kept tight until the car is full to the doors. The barrels so loaded will usually come out just even and make a solid load; if they do not they should be well "chocked" or braced in the center of the car. Unless the barrels are well made the heads and hoops securely and properly in place, even double-headed barrels of potatoes should not be loaded in this manner, but should be placed on end, as suggested for cloth top barrels.

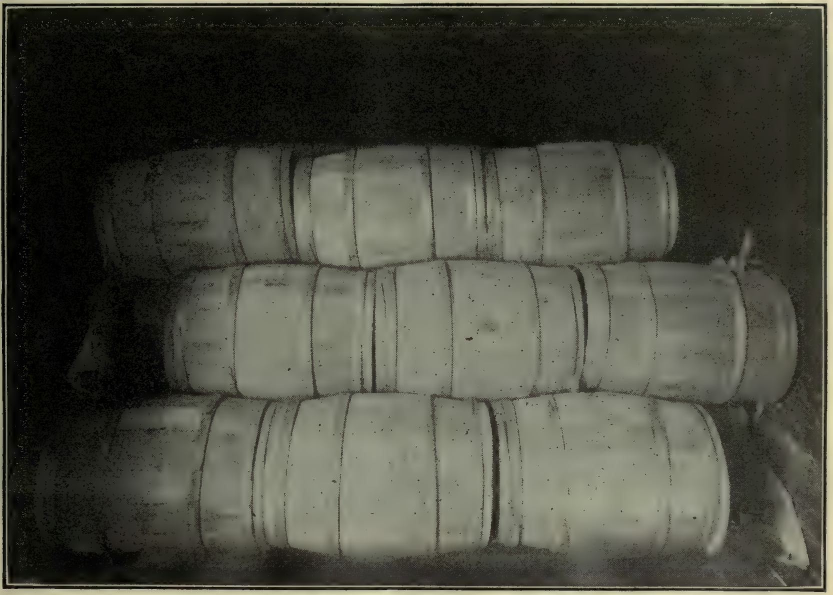

FIG. 16.—Method of loading potatoes in double-headed barrels.

LOADING NEW POTATOES.

Stock cars are generally used for the transportation of new potatoes from the southwest, as they afford plenty of ventilation, which is a prerequisite to satisfactory shipment. Extreme caution should be exercised by the shipper to see that the car is clean and the roof sound. If it is not, the attention of the railroad company should be directed to the defects and either another car should be secured or the defective and dirty one repaired and cleaned, as a dirty car often has a harmful effect on the potatoes.

Loading "Texas" style is the customary manner in the Southwestern States, where plenty of ventilation is required on account of the tenderness of the tubers, heat at time of shipments, and the usually long haul by the transportation companies. Most of the shipping from Texas, Oklahoma, Arkansas, and Louisiana is made by individuals, who superintend their own loading. Usually two men are required to load, although on account of the size of the sacks one man should be able to load a car economically and satisfactorily. An aisle sufficiently wide to permit passage is left from end to end of the car for the purpose of ventilation and inspection. The sacks, which usually contain about 2 bushels, are placed on end from two to four deep on each side of the aisle depending upon the size of the car. Then one layer of sacks is laid flat on top, or two layers may be necessary over a part of the car, in order to reach the minimum carload weight.

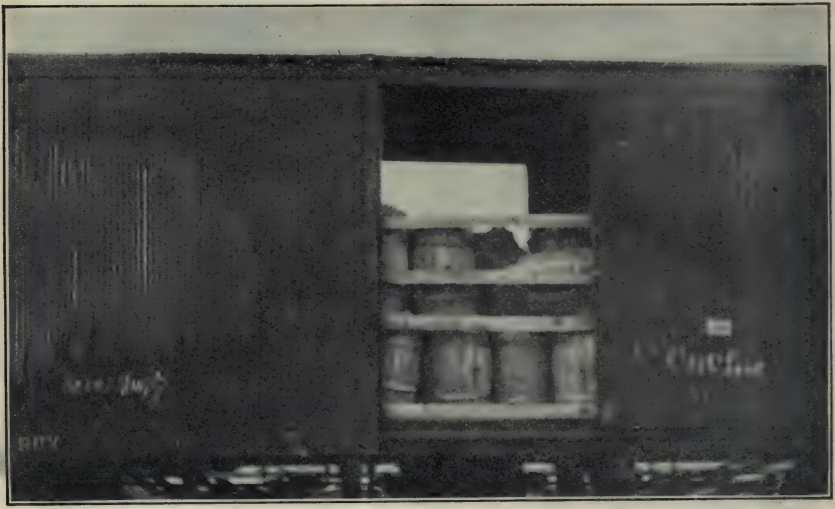

FIG. 17.—Carload of potatoes in cloth-top barrels ready for market.

In some sections of the West a small two-wheeled truck is used to advantage in cars, to truck sacks of potatoes from the door back toward the ends of the car when loading, or to truck from the ends when unloading. This makes the work of loading or unloading much easier and also saves time.

In loading potatoes in cloth or burlap-covered barrels the lowest tier in the car should always be loaded on end with tops up, and the next tier should also be arranged on end if the tier is filled entirely (see fig. 17). This tier is not usually filled and for that reason the last row across the car on each side of the doors should be laid down with the bottoms toward the end of the car. This is done to brace the standing barrels and make the load more secure. Potatoes in cloth or burlap-covered barrels should never be loaded lying down, except for the few barrels to brace the load.

Potatoes in hampers should never be loaded on their sides, because the weight of the upper tiers, combined with the jolting or bumping of the cars, is too likely to crush the lower baskets or tear or force off covers. These hampers should be loaded alternately, the first one top down, the next bottom down and so on. This makes a much safer load and one that will ride well.

LOADING OLD POTATOES.

In the North the sacks are often loaded standing, one tier on end and then another tier on top of the first, during moderately cool weather or prior to October 1; in other cases the second tier of sacks is laid down on top of the first and across the car. To permit a free circulation of air in the car a little space is left between some of the rows.

In cold weather the sacks are usually laid flat, sometimes crosswise and sometimes lengthwise, in the car. They should be piled in even tiers so that they can be checked off and counted readily. In many sections, to prevent freezing in cold weather, a generous supply of straw is piled in the ends on the floor, along the sides of the car, and especially around the doors before loading.

MARKETING.[1]

The distribution of the potato crop varies from year to year with the difference in production in the several principal growing States. Michigan shipped some of its 1915 crop into potato-growing districts of New York State which would have been shipping out hundreds of cars had their crop not been very light. The early potato-producing States of the South scarcely finish digging and shipping out in the spring and summer before they begin shipping in from the northern sections.

Many of the improvements needed to bring about better marketing depend largely upon the grower or shipper. A selling agent, no matter whether he is appointed by a number of growers to sell their crop, or whether he is a commission merchant in whose hands the grower places his potatoes, should have well-graded, uniform, and sound stock put up in a neat, clean, and attractive manner. As long as insufficient attention is given to proper grading and packing, just so long will the results in marketing be unsatisfactory. A cash buyer will usually pay a little more for well-graded potatoes than for stock not uniformly prepared.

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[1] For a discussion of outlets and methods of sale for shippers of fruits and vegetables, see Fisher, J. W., jr.; Collins, J. H.; and Sherman, Wells A., Outlets and Methods of Sale for Shippers of Fruits and Vegetables. U. S. Department of Agriculture Bul. 266, 1915.

For explanation of distribution methods and charges in the city, see Collins, J. H.; Fisher, J. W., jr.; and Sherman, Wells A., Methods of Wholesale Distribution of Fruits and Vegetables on Large Markets, U. S. Department of Agriculture, Bul. 267, 1915.

The marketing methods employed in the southern, or what is better known to the trade as the "new deal," and the northern, or "old deal," are somewhat different. This variance is brought about by different methods employed in handling the crops, periods of maturity, the perishability of the products, length of season, and local custom.

MARKETING SOUTHERN OR "NEW" POTATOES.

The southern crop, on account of its perishable nature, must be marketed quickly, while the northern crop can be held in storage for months. The shipments of the new crop from the Southwest begin in Louisiana and Texas about the 1st of May and continue ordinarily until about the 15th of June, when Arkansas and Oklahoma begin to ship. These districts usually ship until about the 5th of July, when the season of the district around Kansas City, better known as the "Kaw Valley" section, opens up, lasting about six weeks.

One distinctive feature of the "new deal" in the Southwest is that a large number of cash buyers representing different wholesale fruit and produce firms and distributing agencies scattered over the United States come to these sections to buy. The crops are usually sold through local representatives and through distributing agencies who have previously contracted with the growers to sell their crops, although there are many of the growers who sell their own. One advantage to the grower of having a selling agent on the ground is that through the agent handling the crops, the buyers are usually all quoted the same price, thus maintaining a stable, healthy market. The growers who are not selling through this agent apparently have the same outlet through the cash buyers without paying the selling agent's commission, but they do not have the same knowledge of market conditions or of supply and demand. The growers' agent also sells a good percentage of his shipments by wire to his buyers in distant markets at advantageous prices. Usually the independent grower has neither these market connections nor a knowledge of the financial or moral rating of the dealers. As a rule, cash buyers on the ground are quoted a lower price than is quoted to buyers in distant markets by wire.

These selling agents receive a commission on the selling price (or sometimes a fixed amount per car) from the growers and it is to their interest to sell the potatoes for as much as possible, since, when they are selling on a commission basis, their commission will be increased accordingly.

Selling methods along the Atlantic seaboard from Florida north to Virginia differ somewhat from those of the southwestern sections. The cash buyers and distributors are present, but much more consigning to wholesalers is practiced, especially in the Carolinas and the Norfolk section. There are a number of thriving growers' cooperative marketing organizations in this territory, each employing a competent salesmanager to sell the growers' output.

MARKETING NORTHERN OR LATE POTATOES.

Usually the "old deal" can not be handled on the same basis as the "new deal," because about three-fourths of the crop is stored by growers and warehousemen. In nearly every shipping section there are a number of local operators and outside distributors who purchase potatoes extensively at harvesting time and distribute them in car lots during the fall, winter, and spring to all parts of the country. At various points these operators have warehouses for storing the potatoes until they deem it advisable to sell and ship them. Usually the distributors have their main offices in the large cities and their warehouses at convenient shipping points in the potato districts. They buy either from the farmers direct or from the local warehousemen. The selling methods of the local warehousemen and the distributor are about the same, although the latter, perhaps, has the more adequate selling facilities on account of his trade connections.

MARKET OUTLETS FOR NORTHERN GROWERS.

In the field not dug or at an agreed price per bushel for the crop f. o. b. shipping point.—Occasionally a grower will sell his crop in the ground for a lump sum or at a stipulated price per bushel f. o. b. cars at shipping point; the former method, however, is unusual.

For cash by the load as hauled, selling to track buyers, local warehousemen, or distributors.—Growers may use this method and sell when they need cash or when convenient and other work allows time for sorting and hauling.

To cash traveling buyers in carloads.—A grower may make a contract with a track buyer to load one or more cars at a stipulated price. This method is general in some northern sections. The buyer or his representative is usually there to inspect the stock when the car is loaded. Potatoes which are defective in quality or do not come up to grade in some other particular, are thrown out or an allowance is demanded.

To local warehousemen.—In most of the northern producing sections local men who have been growers at one time or business men who saw an opportunity of extending their operations, have entered the potato storing and shipping business. Usually these local men have warehouses (see fig. 18), and some of them are equipped throughout with modern machinery for sorting and handling the potatoes. If the stock is placed in storage for the growers' account the warehouseman may arrange with the grower to charge him a price per bushel for sorting and grading, as well as storing, and if he later sells the potatoes a commission on the selling price is added.

To distributors who may have local warehouses.—The distributor who has his warehouse at the loading station is an important factor in marketing northern potatoes. His storage facilities are an advantage, for they enable him to serve the small grower who has not sufficient acreage to warrant him in providing cellar storage of his own. In this way the business of the small grower may be secured at points where there are no local warehousemen. There are a number of reliable distributors operating at certain points in the late-potato districts each year, owning or leasing warehouses (see fig. 19), on whom the growers rely to some extent to buy or market their crops.

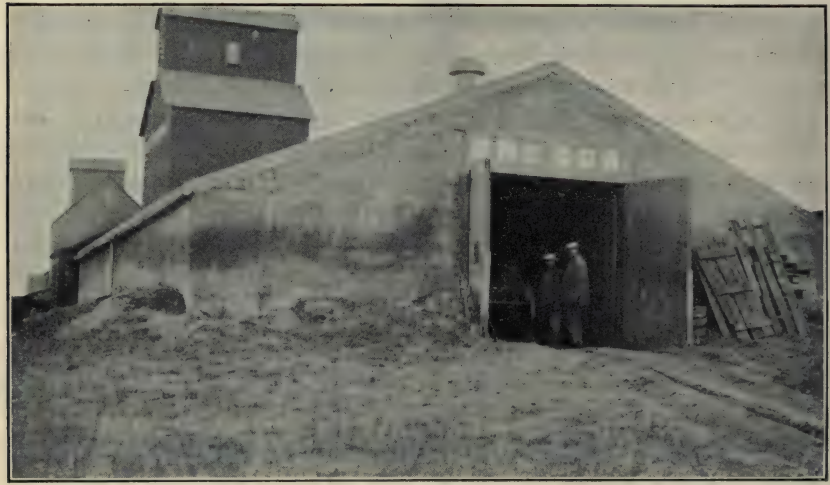

FIG. 18.—Local warehouse of fireproof construction. Driveway through the house facilitates unloading.

Shipping on consignment.—Although most growers and shippers prefer to sell outright, it is generally conceded that under present conditions the commission merchant is a necessary factor in the fruit and produce business. The success of this method of marketing depends very largely on conditions.

Frequently a grower will make the mistake of consigning to a concern of which he knows nothing, or of shipping his potatoes with no knowledge of market conditions or without notifying the commission merchant. It is obvious that the grower should use every effort to obtain accurate information as to the integrity and selling ability of those with whom he expects to do business and then keep in close touch with his agent, previous to shipping, in order that the latter may furnish him the very best information concerning the market conditions. He should always furnish his agent with complete information as to date of shipment, shipping point, car number, initials, route, and contents, either by letter or wire, to reach the commission merchant in ample time before the car arrives, so that arrangements for its sale may be made. Otherwise the merchant may have on track or due a number of other cars. The market may not be in condition to receive further shipments, making it necessary to hold the car on track or to sacrifice or divert it to another market.

One of the reasons why the grower does not receive the highest market price for his potatoes is that he has not learned to ship tubers of good quality uniformly graded. Often he will sell his best potatoes and consign the remainder. The commission merchant should not be condemned severely when the grower receives unsatisfactory reports on such shipments. Criticism should not be based on individual sales, but average results should be considered.

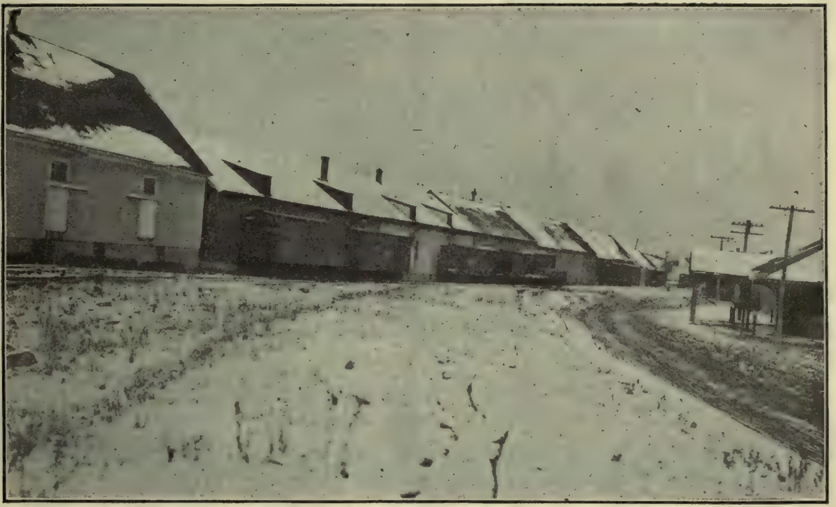

FIG. 19.—Long lines of these warehouses are a common sight at Maine loading points

Selling by wire.—In some cases, particularly when he has had marketing experience, the grower may sell his crop to advantage by wire, in the same manner as does the distributor or buyer, as will be described later. Very few growers have the experience or the trade connections to market in this manner, so the method is not commonly used. The shipper or grower needs an intimate acquaintance or at least a satisfactory basis for dealing with the broker, buyers, and receivers on the markets. Some knowledge of railroad transportation is essential as well.[1] The ability to settle disputes satisfactorily and effect compromises is necessary.

Through a cooperative marketing organization.—Cooperative organizations for marketing table and seed potatoes are increasing in number. This method of marketing deserves the growers' careful consideration and loyal patronage. The possibilities of such organizations when efficiently managed and heartily supported by growers are almost unlimited.

DISTRIBUTORS' OUTLETS.

Since a large part of the northern crop is handled by large distributors, it is well that growers should know how these firms handle their shipments. Some of these outlets are also open to associations and to experienced growers.

The distributor may use several methods in making his sales, as follows:

Through his store in the city to the retail trade.—To sell through his store to the retail trade makes it possible for the distributor to hold a long line of customers who buy regularly or periodically, but who do not buy in sufficient quantities to patronize the produce yards.

A better average profit is secured in this way because to the distributor's car-lot profit is added that of the jobber's. Many times inferior products may be disposed of through the store to a certain trade to very good advantage, and it is often better to dispose of cars which must be sorted in this manner.

In straight car lots in the produce yards or by "breaking" cars to the jobbing or peddling trade.—In some cities an extensive business is carried on in selling "straight" or full cars and in "breaking" or selling by the load out of cars in the railroad produce yards. On the larger markets it is not unusual to see from 50 to 100 or more cars of potatoes on the tracks at one time to be sold. The railroad produce yards of one eastern city are located in the center of the wholesale-produce district and a large percentage of the cars received are sold there in straight carloads to wholesalers, jobbers, chain stores, and peddlers. This is a quick and inexpensive method of selling and it is very desirable on account of the perishability of some commodities.

Breaking cars is a common method of selling and a large volume of this kind of trade is carried on in connection with the car-lot business. The small jobber may buy in this manner in sufficient quantities to supply his requirements. Usually the distributor's gross profit on such sales is greater than in selling straight cars because his selling expense is heavier.

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[1] White, G. C., Demurrage Information for Farmers. U. S. Department of Agriculture, Bulletin 191, 1915.

Consigning to another market either to a broker or to a merchant.—There usually comes a time in some districts when a distributor will be unable to sell all the crop for cash f. o. b. shipping point, or delivered, and will have to consign. On account of his trade connections and the volume of business he controls he probably feels more confident that he will receive fair treatment from the commission merchant than does the grower. The commission merchant is sometimes in a measure dependent upon the distributor for supplies. Sometimes the services of a broker are utilized by the wholesaler or distributor when consigning to outside markets.

Selling for cash to a track buyer at shipping point.—Track selling is carried on quite extensively in all potato-producing districts. The buyers may be traveling brokers or representatives of wholesale firms. Track selling is preferred by some distributors for the reason that the risk in transit due to decay, weather conditions, shrinkage, market decline, and other causes devolves on the buyer.

Selling by "wire" to the trade in other cities either to the wholesaler or jobber direct or through his own representative or broker.—Selling by wire is a very successful method when the wholesaler, shipper, or distributor has the proper market connections, namely, his own representative, a broker in the market, or a personal acquaintance with his customers. The sale may be consummated by telegraph on an f. o. b. shipping-point basis, in transit, or delivered. The distributor has accurate knowledge of how many cars he has to sell, the grade and quality of the stock, and should know approximately the quantities the different markets are receiving and the quantity moving from producing points. With this knowledge and information as to the general market conditions he can quote his products intelligently.

There are several forms in common use among the trade in quoting by wire or letter. The one most commonly used is given below:

BLANK CITY, MINN., *October 10, 1915.*

JOHN DOE, *St. Louis, Mo.*

We offer subject to confirmation shipment to-day number one Early Ohio potatoes one fifty bushel sacked fob here.

JONES & SMITH.

ST. LOUIS, MO., *October 10, 1915.*

JONES & SMITH, *Blank City, Minn.*

Ship John Brown here car number one Early Ohios to-day price quoted confirm with car number weights routing.

JOHN DOE.

BLANK CITY, MINN., *October 10, 1915.*

JOHN DOE, *St. Louis, Mo.*

Shipped John Brown Great Northern nineteen thousand four sixty containing three hundred thirteen sacks weight thirty-seven five sixty routed Burlington.

JONES & SMITH.

In the foregoing wires, Jones and Smith are the shippers of potatoes, located in Blank City, Minn.; John Doe is the broker located at St. Louis, and John Brown is the broker's customer.

When the sale is consummated a record is made of the order, the broker's name, and all particulars. The brokerage on potatoes ranges from $5 to $10 per car, usually each principal paying for his own wires.

RAILROAD BILLING.

There are several ways in which a bill of lading for a car of potatoes may be made.

The car may be billed open to the consignee.—A car may be billed direct to the consignee without an endeavor to secure pay for the potatoes before they are delivered to him. Unless the shipper has confidence in the consignee and knows that he will receive honest treatment at the merchant's hands, billing open is not recommended. However, a large volume of business is conducted in this manner every year.

Billed to the broker or representative.—Large selling organizations and distributors are billing to their broker or representative to some extent. It insures prompt action on the sale of the car, prompt reconsignment of rejected cars, and gives the shipper a personal representative on the ground to look after his interests. The shipper should know of the ability and integrity of the broker or representative.

Billed to the shipper, "shipper's order" notify the consignee.—Sometimes shipments are billed on the "Shipper's Order" form of bill of lading to the shipper himself and a notation is usually made thereon to "permit inspection." Unless the buyer or his agent purchases and inspects the commodity at shipping point, nearly all perishable products are sold with the privilege of inspection at destination. The original bill of lading is usually attached to a draft and sent through the shipper's bank or direct to a bank in the buyer's city. When the car is accepted and draft paid, the buyer receives the bill of lading which, when presented to the railroad, entitles him to possession of the car. Shipping perishables "order notify" is not considered by some of the largest distributors the best practice. As the original bill of lading is usually in the bank attached to the draft, and is therefore out of the possession of the shipper, if the car should be rejected it could not be reconsigned until the return of the bill of lading from the bank or until the shipper could furnish a satisfactory bond to the railroad company. The delay thus entailed on perishables is dangerous and may mean a serious loss to the shipper.

Billed to the shipper, advise or notify the consignee.—The shipper by billing a car to himself, "advise" the consignee, using the "straight" bill of lading, provides a safeguard for himself and at the same time also provides a way by which the car can be expeditiously reconsigned in case it is rejected. When the billing is made out by the shipper billing the car, to himself, advise the consignee, he should note on the bill of lading whether or not inspection is to be permitted. Since this method of billing has come into use within recent years, not only many shippers but some railroad agents are not familiar with it and the latter may request a statement on the bill of lading authorizing the railroad to deliver the car upon presentation of the consignor's written order without surrender of the bill of lading.

An order is made out by the shipper to the delivering railroad company to deliver the car to the buyer upon presentation of this written order without original bill of lading. This order should contain a description of the shipment, giving such information as the shipping point, date shipped, car number and initials, contents and the manner billed, and should be made out on the shipper's letterhead. This order is attached to the draft and either sent through the shipper's bank or direct to a bank in the buyer's town. After the buyer inspects the car and decides that it is satisfactory, by paying the draft, he secures possession of the order or release notice which, when presented to the railroad, entitles him to possession of the car. The delivery notice in this case answers the purpose of a bill of lading to the buyer. If he chooses, the shipper may send to the delivering agent a carbon copy of the delivery notice, also on his letterhead, accompanied by a letter. This prevents misunderstandings of any kind and makes it impossible for the person notified or anyone else to present to the agent a forged order for the delivery of the car.

The advantage in this manner of billing is that the original bill of lading is retained by the shipper and in the event the consignee rejects the car the shipper can reconsign it without any loss of time. Immediate delivery to other buyers may be secured on rejected or diverted cars by telegraphing a release order to the delivering railroad. A number of large shipping organizations are using this method of billing very successfully.

Billed to the shipper himself.—Some distributors or shippers bill their cars to themselves and divert or reconsign from shipping end. When shippers are unable to sell all cars as loaded, it is customary to bill to themselves at some distant city or gateway, expecting to sell while in transit or on arrival. In case of an anticipated rise in the market price this method is often followed, as it may give the distributor several days more time while the car is in transit to take advantage of market prices.

In the event such a car is to be reconsigned or diverted the shipper should notify the railroad agent at shipping point to whom the car is now to be billed, destination, routing, and contents.

In the case of a sale negotiated between the shipper at point of origin and a purchaser in a distant city when the car is billed in this manner, delivery may be accomplished by the shipper wiring the agent of the final carrier to deliver the shipment to the purchaser. This wire should contain all the facts as to point of origin, date shipped, car number, and initials, contents, route, and manner billed.

SHRINKAGE.

A great deal of complaint has been heard on the insufficient allowance made the buyers for protection on actual and natural shrinkage. On the other hand, it is claimed that in some instances an unfair advantage has been taken of shippers or that unreasonable claims are made by receivers.

The natural shrinkage on old potatoes is not as large as on new potatoes. At the same time, in justice to the buyer and seller and for the protection of both, there should be a clear understanding between them on this subject before the sale is consummated. So much dissatisfaction has arisen and so much loss has been encountered from this cause that some reform or the adoption of uniform rules is needed. The question is of great importance to shippers and dealers and will warrant careful investigations to determine what rules should govern.

In the absence of an understanding between the principals the following rules have been observed in some localities:

On sales of western and southwestern potatoes made by wire, terms f. o. b. shipping point, and shipments "billed open" to the purchasers, loading point weights govern.

On sales made on a delivered basis it is customary in many cases to include guarantee of invoice weight within 2 per cent for natural shrinkage on old potatoes and on new potatoes 5 per cent, excepting in several States, such as Maryland, Virginia, and New Jersey, where the guarantee is within 4 per cent.

On f. o. b. shipping point sales, in cases where the potatoes have been billed shipper's order, notify the consignee, the same rule applies as if the terms had been made delivered in the first place, and the shipper guarantees the weight on new potatoes within 5 per cent natural and on old potatoes within 2 per cent. In this case the title to the potatoes does not pass to the buyer or receiver until they arrive at the receiving end.

Serious complaints are made of the unnecessary shrinkage and losses on account of dirt in shipments, as much as five or ten pounds sometimes being found in one sack. It is realized that there is some reason for a limited amount of dirt on shipments dug and forwarded during or following rains, but it is certain that by exercising more care in handling, a large part of the dirt could be eliminated. The use of mechanical sizing or sorting machines is also an aid, since the potatoes are likely to dry off partially, and much of the dirt is rubbed off while going over the machines.

WEIGHING.

There has been considerable dissatisfaction among some buyers and receivers over the loose manner now in vogue of weighing potatoes. It is believed that too little effort is made by shippers to have the weights absolutely accurate and to secure scale tickets.

In the absence of a public weighmaster, all weights should be attested and the buyer should receive a copy of the scale tickets and affidavit. This precaution would enable the buyer, should there be a shortage of sacks, to fortify his claim properly against the railroad company.

In many sections of the North Central States the potatoes are weighed as sorted, in fact, most sorting machines have a bag attachment at one end, the bag being placed on a scale and weighed as the potatoes come out of the machine. To dispel any doubt as to the accuracy of the scales either a public weighmaster should have supervision of the weighing or the scales should be tested frequently and the buyer given an affidavit as to the correctness of the weights.

The safest method is to have every load hauled contain the same number of sacks and have each load weighed and properly recorded over a public or other wagon scale. Potatoes can not be as accurately weighed, one sack at a time, as in loads over large scales.

SUMMARY.

In the large commercial fields machine potato diggers are probably the most economical means of digging when conditions favor their use.

More care must be used in all kinds of digging and handling, and especially in machine digging, to avoid the present large loss and waste from cut and bruised potatoes. Much of this loss is unnecessary and can be avoided by exercising a reasonable amount of care.

Picking directly into crates, which may be loaded upon wagons and hauled to cars or storage, is a better practice than methods which require emptying, rehandling, or shoveling several times.

The results of shipping machine-sized potatoes have been freely commended by buyers and wholesalers. This method should be more accurate, rapid, satisfactory, and when properly managed, more economical than hand sizing.

Machine sizers, usually called graders, will grade potatoes according to size only; in addition, the grower or shipper must give careful attention to the grading for quality. A good practical sizer should have a large apron or table from which the operator may sort the defective tubers and should have a long belt or other sizing device to give the potatoes a sufficient distance to travel in order to be sized properly. A constant supply of potatoes should be available in order to obtain the most economical results and the fullest service of machine and men.

Enormous waste and losses are prevalent in the marketing of this crop, largely owing to the lack of standards, proper grading, and careful handling.

Wholesalers, retailers, and consumers are demanding the use of grading and handling methods which will guarantee a more satisfactory product, that can be sold more readily and prepared for the table, without unnecessary loss.

It is a common statement, and it seems reasonable to believe, that the consumption of potatoes could be increased materially if nothing but well-graded stock were marketed.

Northern potatoes shipped direct from the field at harvest time should receive more careful grading, because the market for later shipments is injured by the shipment of unsatisfactory field stock.

It is an error for growers knowingly to ship potatoes for table use which have been frosted or are affected with blight or other diseases without sorting out all damaged tubers. The payment of freight charges on cull potatoes should be avoided by keeping the culls on the farm.

Potatoes should always be bought from growers by middlemen strictly on their merits. This would reward the careful grower and encourage better grading methods.

In the North dealers and warehousemen are now allowed or forced to do most of the grading. In this way growers lessen their chances of selling direct to city dealers or cash track buyers.

The establishment of uniform standard grades for potatoes is acknowledged to be of the utmost importance, as the greatest need of buyers and sellers is a fixed basis on which to deal.

The fact that standardized products, which may be sold by sample or description, can be handled on a narrower margin of profit than products not uniformly prepared should be an incentive to growers and shippers to adopt adequate standards for this crop.

From present practices two well-defined commercial grades for potatoes appear both necessary and adequate. A special grade may be found advisable for selected, special-purpose stock.

Fruits and vegetables sell largely on their appearance; therefore it is a mistake to attempt to market nearly all of the crop under the first grade unless the potatoes are of strictly first-grade quality. This grade should be made as good and attractive in appearance as is practicable and reasonable. There is an outlet for a No. 2 grade of potatoes; therefore dealers and consumers desiring No. 1 potatoes should not be forced to use ungraded or poorly-graded stock.

Cooperative marketing organizations have proven to be the most efficient agencies in securing a standardized output of potatoes or other vegetables or fruits.

Only new, clean, strong, uniform-sized containers should be used. The 2-bushel burlap bag is believed to be a practical and desirable container to replace the assorted sizes and types of sacks and barrels now used.

Suitable brands are recommended for the best graded potatoes if their quality is always maintained.

Potatoes in any type of container should be loaded into cars securely to prevent loss and damage and claims of all kinds.

Growers should study their marketing situation to learn of all possible outlets and the persons and firms through and to whom they may dispose of their crops. A knowledge of the financial and moral responsibility of these agencies is important and a personal acquaintance very desirable.

The grower's careful attention to the details of selling and forwarding shipments, such as quoting prices by letter and wire, making bills of lading, and advising consignee of details regarding shipments, will save many misunderstandings and losses.

Efforts should be made to avoid unnecessary shrinkage in transit, and every precaution should be taken to secure accurate, complete scale weights.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 754 OCTOBER 14, 1916

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE BEDBUG.[1]

By C. L. MARLATT,

Entomologist and Assistant Chief of Bureau.

CONTENTS.

	Page.
Introduction	1
Origin; common names; distribution	2
Varieties and related insects	3
General characteristics	3
The "buggy" odor	4
Habits and life history	4
Food and longevity	7
Influence of temperature	8
The bite of the bedbug	9
The bedbug and human diseases	9
Natural enemies of the bedbug	10
Remedies	11

INTRODUCTION.

The presence of the bedbug (fig. 1) in a house is not necessarily an indication of neglect or carelessness; for, little as the idea may be relished, this insect may gain access in spite of the adoption of all reasonable precautions. It is very apt to get into the trunks and satchels of travelers, or into baskets of laundry, and may thus be introduced into homes. Unfortunately, also, it is quite capable of migrating from one house to another and will often continue to come from an adjoining house, sometimes for a period of several months, gaining entrance daily. Such migration is especially likely to take place if the human inhabitants of an infested house leave it. With the failure of their usual source of food, the migratory instinct of the bedbugs is developed, and, escaping through windows, they pass along walls, water pipes, or gutters, and thus gain entrance into adjoining houses. In these or other ways anyone's premises may be temporarily invaded.

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[1] *Cimex lectularius* L.; order Hemiptera, suborder Heteroptera, family Cimicidae.

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ORIGIN; COMMON NAMES; DISTRIBUTION.

As with nearly all the insects associated with man, the bedbug has had the habits now characteristic of it as far back as the records run. It was undoubtedly of common occurrence in the dwellings of the ancient peoples of Asia. The Romans were well acquainted with it, giving it the name Cimex. It was supposed by Pliny—and this was doubtless the common belief among the Romans—to have medicinal properties, and it was recommended, among other things, as a specific for the bites of serpents. It is said to have been first introduced into England in 1503, but the references to it are of such a nature as to make it very probable that it had been there long before. Two hundred and fifty years later it was reported to be very abundant in the seaport towns, but was scarcely known inland.

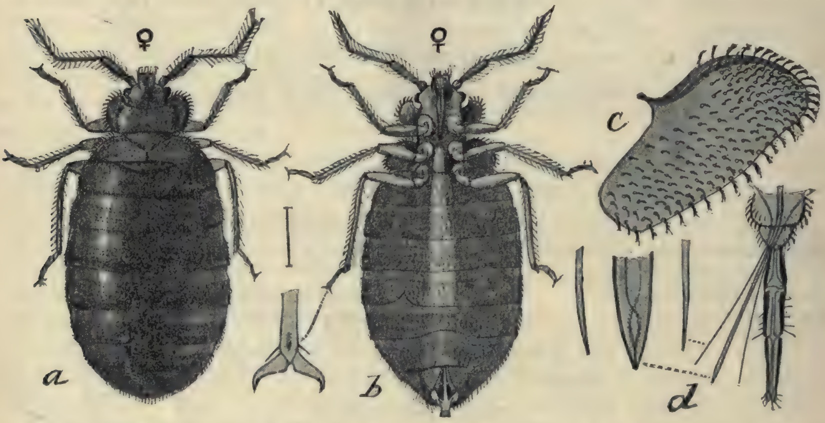

FIG. 1.—Bedbug (*Cimex lectularius*): *a*, Adult female, engorged with blood; *b*, same from below; *c*, rudimentary wing pad; *d*, mouth parts. *a*, *b*, Much enlarged; *c*, *d*, highly magnified. (Author's illustration.)

One of the old English names was "wall-louse." It was afterward very well known as the "chinch," which continued to be the common appellation for it until within a century or two, and is still used in parts of this country. The origin of the name "bedbug" is not known, but it is such a descriptive one that it would seem to have been very naturally suggested. Almost everywhere there are local names for these parasites, as, for illustration, around Boston they are called "chintzes" and "chinches," and from Baltimore comes the name "mahogany flat," while in New York they are styled "red coats," and in the west "crimson ramblers "

The bedbug has accompanied man wherever he has gone. Ships are very apt to be infested with it and have been the chief means of its wide distribution. It probably came to this country with the earliest colonists; at least Kalm, writing in 1748–49, stated that it was plentiful in the English colonies and in Canada, though unknown among the Indians.

VARIETIES AND RELATED INSECTS.

What may eventually prove to be mere variations of the ordinary type of human bedbug have been described as distinct species in several instances. For example, the common bedbug of southern Asia is supposed to present some slight variations from the European type, chiefly in being somewhat more elongate. These slightly diverging forms of the bedbug in different parts of the world, which are not known to have any special bird or animal host other than human beings, may prove to be merely local races or varieties of the ordinary bedbug.

Birds, bats, and poultry are attacked in various parts of the world by a considerable number of parasitic bugs, closely related to the bedbug, which live on their hosts and in nests and about roosting places. One of these species, occurring abundantly in southwestern United States and Mexico,[1] probably originally a parasitic messmate on birds and bats, has come to be an unmitigated poultry pest, and from the close association in these regions between poultry and human beings, is often a serious house pest—more so even than the true bedbug. Others of the species infesting birds and bats may also on occasion become house pests. For example, the nests of the common barn or eaves swallow of this country often swarm with the barn-swallow bug,[2] and from such nests under the eaves of dwelling houses these bugs sometimes gain entrance to houses and beds and are the cause of much annoyance. Similarly a species,[3] normally a parasite of birds and bats in the Old World, and also in Brazil and the West Indies, not infrequently becomes a human parasite.

GENERAL CHARACTERISTICS.

The bedbug belongs to the order Hemiptera, which includes the true bugs or piercing insects, characterized by possessing a piercing and sucking beak. The bedbug is to man what the chinch bug is to grains or the squash bug to cucurbs. Like nearly all the insects parasitic on animals, however, it is degraded structurally, its parasitic nature and the slight necessity for extensive locomotion having resulted, after many ages doubtless, in the loss of wings and the assumption of a comparatively simple structure. Before feeding, the adult (fig. 2) is much flattened, oval, and in color is rust red, with the abdomen more or less tinged with black. When engorged the body becomes much bloated and elongated and brightly colored from the ingested blood. The wings are represented by the merest rudiments, barely recognizable pads, and the simple eyes or ocelli of most other true bugs are lacking. The absence of wings is a most fortunate circumstance, since otherwise there would be no safety from it even for the most careful of housekeepers. Some slight variation in length of wing pads has been observed, but none with wings showing any considerable development has ever been found.

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[1] (*Cimex*) *Haematosiphon inodora* Dugès.

[2] (*Cimex*) *Oeciacus hirundinis* Jenyns.

[3] *Cimex hemipterus* Fab. (synonym, *rotundatus* Sign.).

THE "BUGGY" ODOR.

The most characteristic feature of the bedbug is the very distinct and disagreeable odor which it exhales, an odor well known to all who have been familiar with it as the "buggy" odor. This odor is by no means limited to the bedbug, but is characteristic of most plant bugs also. The common chinch bug affecting small grains and the squash bugs all possess this odor, and it is quite as pungent with these plant-feeding forms as with the human parasite. The possession of this odor, disagreeable as it is, is very fortunate after all, as it is of considerable assistance in detecting the presence of these vermin. The odor comes from glands, situated in various parts of the body, which secrete a clear, oily, volatile liquid. With the plant-feeding forms this odor is certainly a means of protection against insectivorous birds, rendering these insects obnoxious or distasteful to their feathered enemies. With the bedbug on the other hand, it is probably an illustration of a very common phenomenon among animals, i. e., the persistence of a characteristic which is no longer of any especial value to the possessor. The natural enemies of true bugs, against which this odor serves as a means of protection, in the conditions under which the bedbug lives, are kept away from it; and the roach, which sometimes feeds on bedbugs, is evidently not deterred by the odor, while the common house ant and the house centipede, which may also attack the bedbug, seem not to find this odor disagreeable.

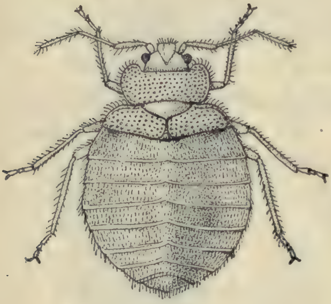

FIG. 2.—Bedbug: Adult before engorgement. Much enlarged. (Author's illustration.)

HABITS AND LIFE HISTORY.

The bedbug is normally nocturnal in habits and displays a certain degree of wariness, caution, and intelligence in its efforts at concealment during the day. Under the stress of hunger, however, it will emerge from its place of concealment in a well-lighted room at night so that under such circumstances keeping the gas or electric light burning is not a complete protection. It has been known under similar conditions to attack human beings voraciously in broad daylight. It usually leaves its victim as soon as it has become engorged with blood and retires to its normal place of concealment, either in cracks in the bedstead, especially if the latter be one of the wooden variety, or behind wainscoting, or under loose wall paper, and in these and similar places it manifests its gregarious habit by collecting in masses. It thrives particularly in filthy apartments and in old houses which are full of cracks and crevices, in which it can conceal itself beyond easy reach. As just noted the old-fashioned, heavy, wooden-slatted bedsteads afford especially favorable situations for the concealment and multiplication of this insect, and the general use in later years of iron and brass bedsteads has very greatly facilitated its eradication. Such beds, however, do not insure safety, as the insects are able to find places of concealment even about such beds, or get to them readily from their other hiding places.

Extraordinary stories are current of the remarkable intelligence of this insect in circumventing various efforts to prevent its gaining access to beds. Most of these are undoubtedly exaggerations, but the inherited experience of many centuries of companionship with man, during which the bedbug has always found its host an active enemy, has resulted in a knowledge of the habits of the human animal and a facility of concealment, particularly as evidenced by its abandoning beds and often going to distant quarters for protection and hiding during daylight, which indicate considerable apparent intelligence.

Like its allies, the bedbug undergoes what is known as an incomplete metamorphosis. In other words, the insect from its larval to its adult stage is active and similar in form, structure, and habit, contrasting with flies and moths in their very diverse life stages of larva, chrysalis, or pupa, and winged adult.

The eggs (fig. 3, *d*) are white oval objects having a little projecting rim around one edge and may be found in batches of from 6 to 50 in cracks and crevices where the parent bugs go for concealment. In confinement eggs may be deposited almost daily over a period of two months or more and commonly at the rate of from one to five eggs per day, but sometimes much larger batches are laid. As many as 190 eggs have been thus obtained from a single captured female.[1]

The eggs hatch in a week or 10 days in the hot weather of midsummer, but cold may lengthen or even double this egg period or check development altogether. The young escape by pushing up the lid-like top with its projecting rim. When first emerged (fig. 3, *a*, *b*) they are yellowish white and nearly transparent, the brown color of the more mature insect increasing with the later molts (fig. 4).

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[1] Girault, A. A. Preliminary studies on the biology of the bedbug, *Cimex lectularius*, Linn. III. Facts obtained concerning the habits of the adult. *In* Jour. Econ. Biol., v. 9, no. 1, p. 25-45. 1914.

During the course of its development the bedbug molts or sheds its skin normally five times, and with the last molt the minute wing pads, characteristic of the adult insect, make their appearance. A period of about 11 weeks was formerly supposed to be necessary for the complete maturity of the insect, but breeding experiments with this insect, conducted in this department in 1896, indicated that the life cycle is subject to great variation, being entirely dependent on warmth and food supply. Under favorable conditions of temperature and food it was found that there was an average period of about eight days between moltings and between the laying of eggs and their hatching, giving about seven weeks as the period under these conditions from egg to adult insect. The molting periods are shorter in the earlier stages and lengthen in the later stages. There are many exceptions, however, and some individuals even under the same conditions remain two or three weeks without molting. Under conditions of famine, or without food, as already shown, the bedbug may remain unchanged in any of the immature stages for an indefinite

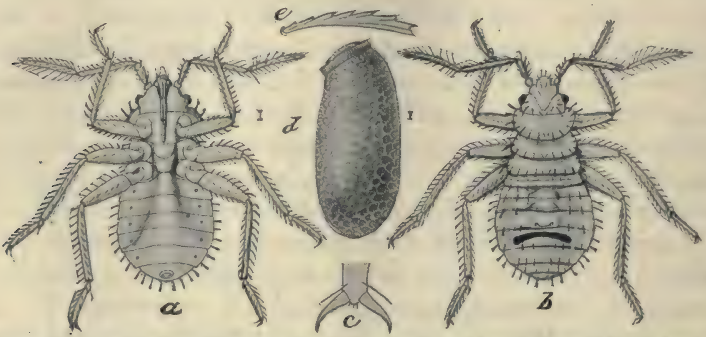

FIG. 3.—Bedbug: Egg and newly hatched larva: *a*, Larva from below; *b*, larva from above; *c*, claw; *d*, egg; *e*, hair or spine of larva. Greatly enlarged, natural size of larva and egg indicated by hair lines. (Author's illustration.)

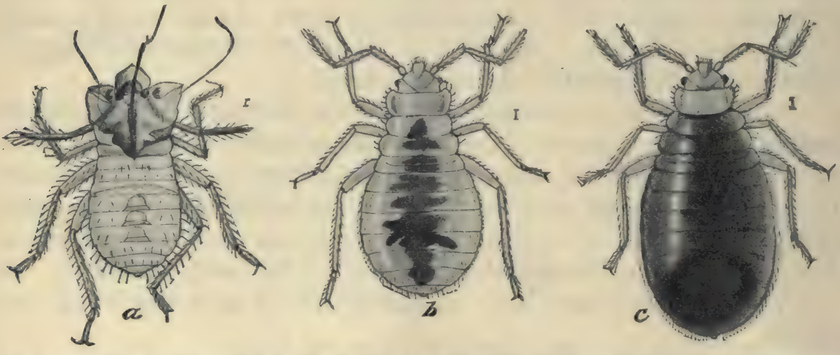

FIG. 4.—Bedbug: *a*, Larval skin shed at first molt; *b*, second larval stage immediately after emerging from *a*; *c*, same after first meal, distended with blood. Greatly enlarged. (Author's illustration.)

time, and the checking of development by such starvation may result in additional molting periods.

The breeding records referred to, and numerous confirmatory experiments subsequently made by other investigators, indicate that ordinarily but one meal is taken between molts, so that each bedbug must puncture its host five times before becoming mature, and at least once afterwards before it can develop eggs. Additional meals between molts may be taken under favoring circumstances, however, and particularly when the insect has been disturbed and has not become fully engorged at its first meal after a molting or other period. The bedbug takes from 5 to 10 minutes to become bloated with blood, and then retires to its place of concealment for 6 to 10 days for the quiet digestion of its enormous meal, and for subsequent molting, or reproduction if in the adult stage.

Such feeding and reproduction may, under favorable conditions of temperature, continue throughout the year, and in one instance the progeny of a captured female adult was carried through three continuous generations.[1]

Unfavorable conditions of temperature and food will necessarily result in great variation in the number of generations annually and in the rate of multiplication, but allowing for reasonable checks on development, there may be at least four successive broods in a year in houses kept well heated in winter.

FOOD AND LONGEVITY.

Under normal conditions the food of the common bedbug is obtained from human beings only, and no other unforced feeding habit has been reported. It is easily possible, however, to force the bedbug to feed on mice, rats, birds, etc., and probably it may do so occasionally in nature in the absence of its normal host. The abundance of this insect in houses which have long been untenanted may occasionally be accounted for by such other sources of food, but probably normally such infestation can be explained by the natural longevity of the insect and its ability to survive for practically a year, and perhaps more, without food.

There are many records indicating the ability of the bedbug to survive for long periods without food, and specimens have been kept for a year in a sealed vial with absolutely no means of sustenance whatever. In the course of the department's study of this insect in 1896, young bedbugs, obtained from eggs, were kept in small sealed vials for several months, remaining active in spite of the fact that they had never taken any nourishment whatever. A considerable series of experiments was later conducted by Girault,[1] bearing on the longevity of the insect under different conditions. A large number of adults of both sexes were kept in confinement, but with normal feeding and mating, and these survived for periods ranging from 54 to 316 days. Similarly, the life of 71 newly hatched larvæ, without food, ranged from 17 to 42 days, averaging about 28 days. Partly grown captured insects lived without further feeding from 17 to 60 days. Longevity is naturally affected more or less by temperatures. In other words, temperatures sufficient to check the activity of the insect and produce hibernation or semihibernation are apt to increase longevity.

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[1] Girault, A. A. Preliminary studies on the biology of the bedbug, *Cimex lectularius*, Linn. II. Facts obtained concerning the duration of its different stages. *In* Jour. Econ. Biol., v. 7, no. 4, p. 163–188. 1912.

The fact that the bedbug is able to survive for such long periods without human blood has led to the theory that it could subsist in some fashion on the moisture from wood or from accumulations of dust in crevices in flooring, etc. There seems to be no basis of observed fact for this idea.

Another very prevalent belief among the old settlers in the West, that this insect normally lives on dead or diseased cottonwood logs, and is almost certain to abound in log houses of this wood, seems to be equally devoid of basis. As illustrating this belief, the department has on file a very definite report from an Army officer that the bedbug often occurs in numbers under the bark of dead cottonwood trees,[2] especially along the Big Horn and Little Horn Rivers in Montana. The basis of this report and the origin of this very general misconception is probably, as pointed out by the late Prof. Riley, due to a confusion of the bedbug with the immature stages of an entirely distinct insect,[3] which somewhat resembles the bedbug and often occurs under cottonwood bark.

INFLUENCE OF TEMPERATURE.

As a messmate of human beings in dwelling houses, the bedbug is normally protected from extreme cold, and is known to be an abundant and serious pest far north. In fact, it is often more troublesome in north temperate latitudes than farther south. This may be accounted for partly by the fact that the bedbug is very sensitive to high temperatures, and a temperature of 96° to 100° F. or more, accompanied with a fairly high degree of humidity, results in the death of large numbers of the bugs. The mature or partly mature bedbugs can stand comparatively low temperatures, even below freezing, for a considerable period. The eggs and newly hatched larvæ, however, succumb to a temperature below freezing, if this condition is prolonged for from 15 days to a month. The feeding and developing activity of the insect practically ceases at 60° F., the insect remaining quiescent and in semihibernation at temperatures below this point. The most favorable temperatures for activity are between 60° and 98° F.[1] The activity of the insect is controlled entirely by temperature and food supply, and, therefore, in heated houses the insect may remain active throughout the winter. There is some protection in winter, therefore, in sleeping in cold bedrooms.

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[1] Loc. cit.

[2] *Populus monilifera.*

[3] *Aradus* sp.

THE BITE OF THE BEDBUG.

The bite of the bedbug is decidedly poisonous to some individuals, resulting in a slight swelling and disagreeable inflammation. To such persons the presence of bedbugs is sufficient to cause the greatest uneasiness, if not to put sleep and rest entirely out of the question. With others, however, who are less sensitive, the presence of the bugs may not be recognized at all, and, except for the occasional staining of the linen by a crushed individual, their presence might be entirely overlooked. The inflammation experienced by sensitive persons seems to result chiefly from the puncture of the skin by the sharp piercing setæ which constitute the puncturing element of the mouth parts, as there seems to be no secretion of poison other than the natural fluids of the mouth.

The biting organ of the bedbug is similar to that of other insects of its order. It consists of a rather heavy, fleshy under lip (the only part ordinarily seen in examining the insect), within which lie four threadlike hard filaments or setæ which glide over one another with an alternating motion and pierce the flesh. The blood is drawn up through the beak, which is closely applied to the point of puncture, and the alternating motion of the setæ in the flesh causes the blood to flow more freely. The details of the structure of the beak are shown in figure 1 at *d*.

To allay the irritation set up by the bite of the bedbug, peroxide of hydrogen, or dioxygen, may be used with good results.

Tincture of iodine either at ordinary or double strength is also a good counter-irritant for use in cases of flea, mosquito, bedbug, and other insect bites, but should be used with caution on the tender skin of small children and on those who are affected with or disposed to eczemic disorders.

THE BEDBUG AND HUMAN DISEASES.

In common with other insects which attack man and warm-blooded animals, it is entirely possible for the bedbug and its close allies to be transmitters of contagious human diseases, and already these insects have been shown to be possible carriers or transmitters of a considerable series of diseases, including infantile Kala-azar of northern Africa and southern Europe, relapsing fever of Africa and Europe, the Chagas fever of Brazil, tropical sore, plague, and possibly leprosy. In the case of these, and perhaps other diseases, the bedbug shares the responsibility of transmitter with other biting insects, such as body lice and fleas.

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[1] Bacot, A. W. The influence of temperature, submersion, and burial on the survival of eggs and larvæ of *Cimex lectularius*. *In* Bul. Ent. Res., v. 5, pt. 2, p. 111–117. 1914.

The particular rôle of the bedbug as a carrier of disease has not been satisfactorily determined, nor has it been shown that the bedbug is a necessary alternate host in any instance. In general, the transmission of disease by this insect has apparently resulted from the accidental carriage of the disease elements on the mouth parts, as pointed out by André,[1] after a careful study of the subject. As a parasite of human beings in private dwelling houses, where it may seldom change its host, the opportunity for the bedbug itself to become infected with human diseases and again to transmit them to the human subject is very remote. This condition, however, does not apply to hotels or to passenger boats, where the human occupants are constantly changing. Furthermore, the fact that the bedbug attacks its host at comparatively long intervals of from a week to several weeks or months acts as a bar to its transmission of certain insect-borne diseases, the biology of which requires a definite and comparatively short period of development in the alternate insect host.

NATURAL ENEMIES OF THE BEDBUG.

Living always in houses as it does and being well concealed, the bedbug is not normally subject to much if any control by natural enemies. Certain other household insects, however, do occasionally prey upon the bedbug, as, for example, the house centipede [2] and the common little red house ant.[3] Such enemies, however, are of very small importance and yield little, if any, effective control except under very exceptional circumstances. One such instance is reported by the late Mr. Theodore Pergande, of this department, who states that as a soldier in the Civil War he occupied at one time a barracks at Meridian, Miss., which had been abandoned some time before. The premises proved to be swarming with bedbugs; but very shortly afterwards the little red house ant discovered the presence of the bedbugs and came in enormous numbers, and Mr. Pergande witnessed the very interesting and pleasing sight of the bedbugs being dismembered and carried away bodily by these very minute ants, many times smaller than the bugs which they were handling so successfully. The result was that in a single day the bedbug nuisance was completely abated. The liking of red ants for bedbugs is confirmed also by a correspondent writing from Florida (F. C. M. Boggess), who goes so far as heartily to recommend the artificial introduction of the ants to abate this bug nuisance.[1] Bedbugs and other household insects, however, are not of the sort which it is convenient or profitable to turn over to their natural enemies in the hope that eradication by this means will follow, and the fact that they are preyed upon by other insects furnishes no excuse to the housekeeper for not instituting prompt remedial measures.

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[1] André, Ch. Recherches anatomiques et expérimentales sur la punaise des lits. *In* Jour. Physiol. et Path. Gén., v. 14, p. 600-615. 1912.

[2] *Scutigera forceps* Raf.

[3] *Monomorium pharaonis* L.

REMEDIES.

Undoubtedly the most efficient remedy for the bedbug is to fumigate the infested house or rooms with hydrocyanic-acid gas. This gas will penetrate into every crevice in the house or room where the bedbugs conceal themselves and has an immediate effectiveness which gives it an important recommendation, especially when the infestation is considerable or of long standing. This method of fumigation should be intelligently employed, as the gas is deadly poisonous. A bulletin giving directions for such fumigation has been issued by the Department of Agriculture.[2]

The fumes of burning sulphur are also a very efficient means of control where the conditions are such that this method can be used, readily destroying the insect in all stages, including the egg. The treatment is inexpensive compared with the use of hydrocyanic-acid gas and offers much less risk of danger to human beings. There is, however, a considerable risk of injury to household fabrics, furnishings, and wall papers from the strong bleaching quality of sulphur fumes. This danger will be somewhat diminished if the fumigation can be done at a time when the room or house is thoroughly dried out, as in winter by a furnace or other heating system. Further precautions should be taken by removing all metallic surfaces from the room or building, or by protecting them with a coating of vaseline. Two pounds of sulphur are recommended for each 2,000 cubic feet of space, and the building should be closed for the treatment for at least 5 or 6 hours, or preferably for 24 hours. Sulphur candles may be used where available, or the sulphurous gas or fumes can be generated by burning the sulphur in a dish placed in the center of the room, and for protection set within a larger vessel. Thorough-going precautions must be taken to prevent accidental overflowing or the starting of a fire, and after the fumigation the house should be given a thorough airing.

Other gases have been experimented with, such as formalin and the vapors of benzine, naphthaline, and camphor, but these gases are of little value. Similarly, insect powders are of little value, largely from the difficulty of getting them into the crevices and other places of concealment of the insects.

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[1] Bedbugs and red ants. *In* Insect Life, v. 6, no. 4, p. 340. 1894.

[2] Howard, L. O., and Popenoe, C. H. Hydrocyanic-acid gas against household insects. U. S. Dept. Agr. Farmers' Bul. 699. 8 p. 1916.

The old-fashioned household remedies referred to below are effective enough, though at a greater cost of time and personal effort. They will, however, be often of much service in the case of slight or recent infestations, or where the employment of more poisonous and troublesome gases is objected to or is impracticable. Of these simple methods of control perhaps the most efficient is in very liberal applications of benzine or kerosene, or any other of the lighter petroleum oils, introduced with small brushes or feathers, or by injecting with syringes into all crevices of beds, furniture, or walls where the insects may have concealed themselves. Corrosive sublimate is also of value, and oil of turpentine may be used in the same way. The liberal use of hot water, wherever it may be employed without danger to furniture, etc., is also an effectual method of destroying both eggs and active bugs.[1]

Various bedbug remedies and mixtures are for sale, most of them containing one or another of the ingredients mentioned, and these are frequently of value. The great desideratum, however, in a case of this kind, is a daily inspection of beds and bedding, particularly the seams and tufting of mattresses, and of all crevices and locations about the premises where these vermin may have gone for concealment. A vigorous campaign should, in the course of a week or so at the outside, result in the extermination of this very obnoxious and embarrassing pest.

The possibility of temperature control is indicated in the discussion elsewhere of the effect of temperature on this insect, and it may be that if infested houses in cold climates could be opened up and allowed to remain at a temperature well below freezing for a week or more, the bedbug would be thoroughly exterminated. This method of control would be rarely practicable except perhaps in the case of summer houses which are left untenanted in winter.

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[1] A remedy for the bedbug has been devised by Mr. R. H. Pettit ("Notes on two insecticidal agents," *in* 10th Rpt. Mich. Acad. Sci., p. 159–160, 1908) as a substitute for hydrocyanic-acid gas and sulphur, and is reported to have proved very successful. The preparation of this insecticide and its application is described as follows:

> Alcohol is drawn through pyrethrum in a funnel until the powder is well washed and a large part of the resinous principle extracted. To do this, the powder is placed in a large funnel with filter-plate and a layer of cotton wool at the bottom. An aspirator is attached and the alcohol is at first slowly and later rapidly sucked through six or eight times, during which operation it becomes highly colored. To this liquid as a basis, are added several oils to give permanence to the application. Both alcohol and pyrethrum evaporate so quickly that it was thought best to carry in some heavier volatile oils whose effects would last several days or even weeks. The formula when completed stands as follows:
>
> To the extract made by washing 400 grams of pyrethrum with 2,000 c. c. of strong alcohol, are added—
> 50 grams gum camphor.
> 150 c. c. cedar wood oil.
> 25 grams oil citronella.
> 25 grams oil lavender.
>
> The application is best made with a large sized atomizer, one holding a pint or more and working with a piston instead of a rubber bulb. * * * To obtain the best results, repeat the treatment after about two weeks. We have tried this mixture repeatedly, and with uniformly gratifying results. Usually one application, if thoroughly made, put a period to the complaints, about eight or ten ounces being required in an average sleeping-room. The odor remains some little time in a room, but is not disagreeable to the average person.

This remedy can be readily prepared by a pharmacist in any drug store.

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 755 OCTOBER 26, 1916

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.

COMMON BIRDS OF SOUTHEASTERN UNITED STATES IN RELATION TO AGRICULTURE.

By F. E. L. BEAL, W. L. MCATEE, and E. R. KALMBACH,
Assistant Biologists.

CONTENTS.

Page.
Introduction 1
House wren 5
Carolina wren 7
Mockingbird 9
Brown thrasher 11
Cardinal 13
Gray grosbeak 14
Painted bunting 15
Common crow 17
Blue jay 18
Meadowlark 19
Boat-tailed grackle 22
Bluebird 23
Carolina chickadee 24
Tufted titmouse 26
Purple martin 28
Scissor-tailed flycatcher 29
Red-cockaded woodpecker 31
Chuck-will's-widow 32
Nighthawk 33
Yellow-billed cuckoo 34
Bob-white 36
Swallow-tailed kite 37
Turkey buzzard 37

INTRODUCTION.

By W. L. MCATEE.

In the Southeastern States, as restricted for the purposes of this bulletin (fig. 1), there occur at some season of the year more than 460 species of birds. Of these, about 280 are common, and the number includes some of the handsomest birds of the United States, as the scissor-tailed flycatcher, the painted bunting, and the cardinal; besides some of the most pleasing songsters, as the last-named species, the mockingbird, the brown thrasher, and the Carolina wren. The general habits, and particularly the economic value, of 23 of the best-known species are treated in the following pages.[1]

The food habits of southeastern birds are of particular interest on account of the prevalence in this section of the country of a number of the worst insect enemies of agriculture, many of which are eagerly sought by birds. One need only recall such pests as the cotton boll weevil, the bollworm, and the chinch bug to realize with what serious foes the farmer of the Southeastern States has to contend. It is hoped that knowledge of the part birds play in combating his enemies will lead the southern farmer to take an active interest in securing full protection for these, his feathered allies.

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[1] For a list of department publications relating to the food of certain other birds inhabiting this same area, see last page of this bulletin.

NOTE.—The food habits and relation to agriculture of 23 species of birds common in the Southeastern States are described; of general interest but especially applicable to the section covered.

Cotton being the leading crop in the Southeast, the bird enemies of cotton insect pests naturally deserve first consideration. Few in all this broad land are ignorant of the tremendous damage done by the cotton boll weevil. For some years it has easily ranked as the most destructive pest in the United States. Special study of its bird enemies has been made, and the result is that 66 species are now known which, to a greater or less extent, prey upon the boll weevil. A list of these, which constitutes a roll of honor among southeastern birds, is here given:

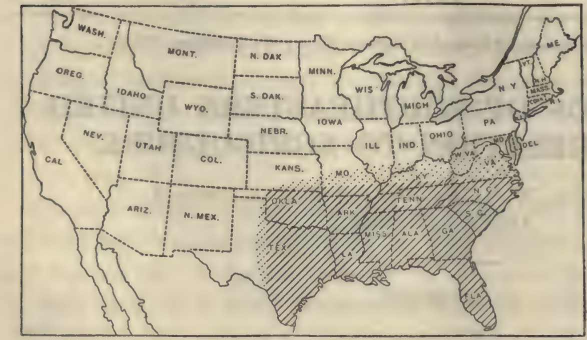

FIG. 1.—Map of the United States, the shaded area showing the territory to which this bulletin applies.

BIRD ENEMIES OF THE COTTON BOLL WEEVIL.

Upland plover.
Killdeer.
Bob-white.
Red-headed woodpecker.
Flicker.
Nighthawk.
Chimney swift.
Scissor-tailed flycatcher.
Kingbird.
Crested flycatcher.
Phœbe.
Olive-sided flycatcher.
Wood pewee.
Alder flycatcher.
Least flycatcher.
Blue jay.
Cowbird.
Red-winged blackbird.
Meadowlark.
Western meadowlark.
Orchard oriole.
Baltimore oriole.
Bullock oriole.
Rusty blackbird.
Brewer blackbird.
Bronzed grackle.
Boat-tailed grackle.
English sparrow.
Vesper sparrow.
Savannah sparrow.
Lark sparrow.
White-throated sparrow.
Field sparrow.
Chipping sparrow.
Swamp sparrow.
Fox sparrow.
Towhee.
Cardinal.
Gray grosbeak.
Blue grosbeak.
Painted bunting.
Indigo bunting.
Dickcissel.
Purple martin.
Cliff swallow.
Barn swallow.
Tree swallow.
Bank swallow.
Rough-winged swallow.
Loggerhead shrike.
White-eyed vireo.
Yellow warbler.
Myrtle warbler.
Pine warbler.
Maryland yellow-throat.
Yellow-breasted chat.
American pipit.
Mockingbird.
Brown thrasher.
Carolina wren.
Bewick wren.
Winter wren.
Tufted titmouse.
Black-crested titmouse.
Carolina chickadee.
Bluebird.

The most active of these enemies of the boll weevil are the orioles, which actually take the insects from the squares of the cotton plant, and the swallows, which feed upon the weevils when they are in flight and seeking to extend their range. No fewer than 41 boll weevils have been found in a single stomach of the Bullock oriole, and large numbers of the weevils are habitually taken by all species of swallows. Every one of a series of 35 eave swallows had eaten boll weevils, the largest number in any stomach being 48, and the average 19. In winter the most important destroyers of these insects are blackbirds, meadowlarks, titlarks, and Carolina wrens.

Forty-one species [1] of birds feed upon the cotton worm. Of these bird enemies, cuckoos are most effective, since they frequently consume from 100 to 150 cotton worms at a meal. The orioles again deserve especial mention, as do also the crow, the curve-billed thrasher, mockingbird, cardinal, and gray grosbeak. The bollworm, or corn-ear worm, is attacked by 12 southeastern birds, of which the boat-tailed grackle, or jackdaw, has the best record. Seven species of birds feed upon the cotton cutworm.

If insect pests are considered in the order of the importance of the crops they attack, those damaging corn and other grain crops probably are next to the cotton insects. White grubs are a serious pest not only to corn but to strawberries, various garden crops, and grasses. Fifty-seven species of southeastern birds devour white grubs or the adult forms known as May beetles. The nighthawk, chuck-will's-widow, crow, and screech owl are the most voracious feeders on the adults, and the crow, crow blackbird, and robin on the larvæ. Remains of no fewer than 91 adults have been found in a single stomach of the nighthawk, or bull-bat, a bird which has been much persecuted but which deserves the strictest protection.

Wireworms are especially injurious to corn, but they damage all other grains, as well as many garden crops. These pests are the larvæ of click beetles, of which there are many species. One hundred and twenty-eight southeastern birds include click beetles or wireworms in their bill of fare. The most efficient destroyers of these pests are the following: Downy and red-bellied woodpeckers, nighthawk, kingbird, great-crested flycatcher, crow, blue jay, crow blackbird, red-winged blackbird, lark sparrow, tree swallow, purple martin, house wren, and robin. From 20 to 40 wireworms have been found in each of several robin stomachs.

Corn is seriously damaged by billbugs also. The larvæ bore into the stem and the adult weevils injure the leaves. Fifty-five species of birds occurring in the Southeastern States feed upon these insects. Those consuming the largest numbers are the killdeer, upland plover, nighthawk, crow, red-headed woodpecker, and the yellow-headed and crow blackbirds. Forty-three kinds of birds feed upon the army worms, pests destructive to corn and all small grains. Eighty-eight southeastern species devour cutworms, which are often the despair of grain growers and gardeners. Largest numbers of cutworms have been found in stomachs of the prairie chicken, bob-white, wood duck, woodcock, sparrow hawk, yellow-billed cuckoo, nighthawk, red-headed woodpecker, crow blackbird, meadowlark, English sparrow, cardinal, and robin.

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[1] This and similar figures in the remainder of the introduction must be understood as representing only present knowledge—other species may at any time be added to the lists of bird enemies of the various insect pests.

No insect enemy of corn and wheat is more destructive than the chinch bug; when it is numerous, fields are blasted as if by fire. It is often said that the chinch bug has few natural enemies, but the work of birds, 24 species of which feed upon chinch bugs, should not be overlooked. Over 100 of these pests have been found in single stomachs of the bob-white and meadowlark, and over 200 in one of a brown thrasher. Other birds consuming chinch bugs in considerable numbers are the flicker, the crow, the barn, tree, and cliff swallows, and the house wren. The southern corn leaf beetle, a pest that has come to be of considerable importance in the past few years, is devoured by 22 kinds of birds. Those taking the largest numbers are the mockingbird, the Bewick wren, and the house wren.

Among other corn insects may be mentioned the southern corn rootworm (or spotted cucumber beetle), eaten by 26 species of southeastern birds; beetles of a group including the cane root borer and the carrot beetle, devoured by 18 species; and the brown fruit-chafer, by 21. The last-named beetle feeds also on apples, pears, and peaches, as does a related insect known as the southern fig eater. Fourteen species of birds prey upon the fig eater, the crow most extensively.

The insect pests of clover and other forage crops in the Southeastern States also are sought by many birds. Perhaps more damage is done in the aggregate by leafhoppers than by other enemies of these crops. Exactly 100 species of southeastern birds are now known to feed on these small but exceedingly numerous insect pests. Largest numbers of leafhoppers have been found in stomachs of the nighthawk, chimney swift, barn swallow, and yellow-headed blackbird. Clover is attacked by a number of insect pests, including the imbricated-snout beetle and the various clover weevils. The first named is eaten by 20 kinds of birds, of which the crow, crow blackbird, and catbird seem most voracious. The common or large clover leaf weevil is the prey of 25 species of birds. The nighthawk, crow, red-headed woodpecker, purple martin, and crow blackbird have the best records for destruction of adults, and the Savannah and vesper sparrows of the larvæ. The smaller clover weevils are eaten by 74 species of southeastern birds. Largest numbers of these weevils have been found in the stomachs of the robin, hermit thrush, tufted titmouse, and white-crowned sparrow, and of the following four species of birds, some representative of each of which had consumed at one meal more than 50 individuals: Nighthawk, chimney swift, tree swallow, and purple martin.

It is perhaps worth while to mention the bird predators upon certain insect enemies of truck crops. The destructive little cucumber flea beetle and its congeners, which feed on potato, tomato, sweet potato, eggplant, and tobacco, are preyed upon by 19 species of southeastern birds. The sweet potato flea beetle and its allies have 28 known bird enemies in this section; the grapevine leaf beetle, 21; the grape flea beetle, 23; and the bean leaf beetle, 19. The rice weevil has been found in stomachs of 20 species of birds, the notorious Colorado potato beetle in 26, and the periodical cicada, or 17-year locust, in 33. Pests of considerable importance in the South whose bird enemies it is well to mention are the horseflies. These are preyed upon by 49 species of southeastern birds. The stomach of one killdeer contained 40 horsefly larvæ.

The foregoing demonstrates that many of the worst pests of southern agriculture have enemies in the bird world. The insects which have been considered chiefly are those destructive to grain and field crops; but among forest insects, fruit insects, and all the host that prey upon truck and garden crops, few can be mentioned that do not have important bird enemies. Farmers should recognize their friends and do all in their power to protect them.

HOUSE WREN.[1]

The house wren (fig. 2), a fussy, flighty, and fidgety little midget, frequents the vicinity of barns and gardens and particularly old orchards where the trees are partially decayed. Never for a moment at rest while there is a ray of daylight, it would seem that his small body must soon be worn out by his incessant activity. His voice, as tireless as his wings, is heard from morning until night about the garden and orchard where he seeks his daily food, and while not very melodious it is cheerful and suggestive of life and activity.

Probably no bird displays greater eccentricity in the selection of a nesting site than the house wren. A hollow branch or a knothole in a post or stump are his more prosaic choices. When more esthetically inclined he affects old boots or hats hung up to scare the robin from the cherries, or takes an old copper pot or tomato can lying on the roof of a back shed; or, if the gardener hangs his coat on the fence when warm weather begins and forgets it for a few days, he may find when he returns that an enterprising wren has preempted one of the pockets and has his domestic affairs under full headway. The empty skull of a horse or cow when set on a post by the frolicsome schoolboy makes an excellent nesting place for the wren, who is never troubled by the ghost of the former occupant. Whatever place he chooses, his ambition is to occupy the whole of it. This he accomplishes by carrying in sticks, straws, and other rubbish until all available space is filled, only just room enough being left for the mother bird and her eggs.

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[1] *Troglodytes aëdon.*

Curious as may be the nesting habits of this little creature, his chief interest to the farmer and gardener centers about his tastes in the matter of food. He aspires to a large family; six to a brood is his favorite number, and this he likes to duplicate once or twice in the course of the summer; of course so many mouths to be filled require great activity on the part of the head of the family, but the wren is fully equal to the task and his brood never suffers from hunger. He is an industrious forager, searching every tree, shrub, and vine for caterpillars and examining every post and rail of the fence and every cranny in the wall for insects and spiders.

The wren is found all over the United States east of the Great Plains in summer and it winters in the Southern States.

For the purpose of this paper the food of 68 birds was examined and found to consist entirely of animal matter (mostly insects). The largest four items, taken in the order of their size, are bugs, grasshoppers and their allies, caterpillars, and beetles. Beetles collectively constitute 13.81 per cent of the food. Of these, the predacious ground beetles and a number of "ladybugs" (3.03 per cent) are practically the only useful insects eaten by the wren. Snout beetles, or weevils (4.93 per cent), are eaten in every month of the wren's stay in the South. Other beetles (5.85 per cent) are largely of the leaf-beetle family, to which belong some of the greatest pests in the insect world.

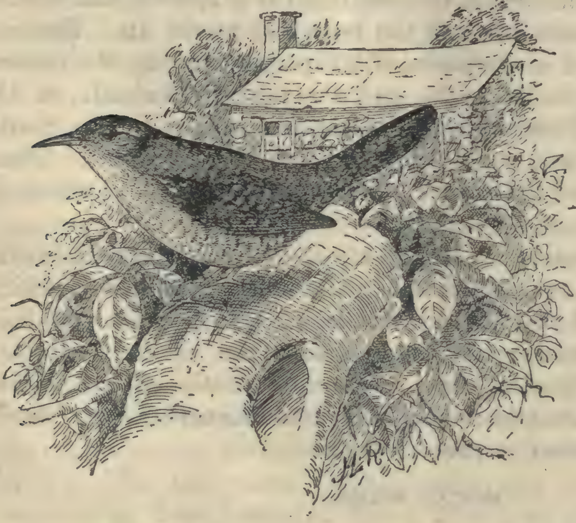

FIG. 2.—House wren. Length, about 5 inches.

Moths and caterpillars reach very nearly the same percentage as beetles. The former are eaten to the extent of 13.9 per cent, but many are adult insects instead of caterpillars. The wren seems to have a decided taste for these fuzzy creatures.

Grasshoppers and their kin—crickets, locusts, etc.—were represented in the food of every month in goodly numbers, the aggregate being 17.61 per cent. The greatest consumption occurred in January (31.2 per cent) and November (31 per cent); the smallest, a mere trifle, in April. The largest item in the food is made up of bugs (29.34 per cent), chiefly stinkbugs, a few negro bugs, and some leafhoppers; but a good many more are those slim-bodied, long-legged, slow-moving creatures that may be found straddling over the herbage about pools or wet places and over bushes. The thread-legged bugs and marsh treaders are examples. As these creatures have no great economic significance, so far as known, the wren does neither good nor harm in eating them. The stinkbugs, negro bugs, and tree-hoppers and leafhoppers are harmful insects, and in eating them and feeding them to its young the wren is an aid to the agriculturist.

Ants are eaten to the extent of 8.2 per cent of the yearly food, and in March constitute 22.67 per cent. Bees and wasps amount to 3.27 per cent. Flies, a mere trifle in the food of the wren, are evidently left to the more fleet flycatchers and swallows.

Spiders are acceptable and are captured every month in the season. The wren finds these when searching under piles of lumber or brush, stone walls, hollow logs, outhouses, and sheds. They aggregate 10.51 per cent of the food, and in March 32.5 per cent. Millepeds (thousand-legs) form a part (2.76 per cent) of the food of the first four months of the year, six-sevenths of them being eaten in April. Other creatures, as sowbugs and snails, were found in a few stomachs, but are a negligible quantity.

No accusation has been brought against the wren that it harms fruit or other farm products. Both field observation and stomach examination show that it consumes great numbers of noxious insects, thereby benefiting the farmer and gardener. It is a cheery, bustling little creature to have about the homestead and should be thoroughly protected. Put up a box where cats can not get at it and the wren will pay good rent.—F. E. L. B.

CAROLINA WREN.[1]

The Carolina wren (fig. 3) is resident from the Gulf of Mexico north to the southern boundaries of Iowa, Illinois, and Connecticut in the breeding season, but in winter withdraws somewhat farther south. It is a bird of the thicket and undergrowth, preferring to place its nest in holes and crannies but when necessary will build a bulky structure in a tangle of twigs and vines. Unlike the house wren it does not ordinarily use the structures of man for nesting sites. It is one of the few American birds that sing throughout the year. Most birds sing, or try to, in the mating season, but the Carolina wren may be heard pouring forth his melody of song every month. The writer's first introduction to this bird was in the month of January when he heard gushing from a thicket a song which reminded him of June instead of midwinter.

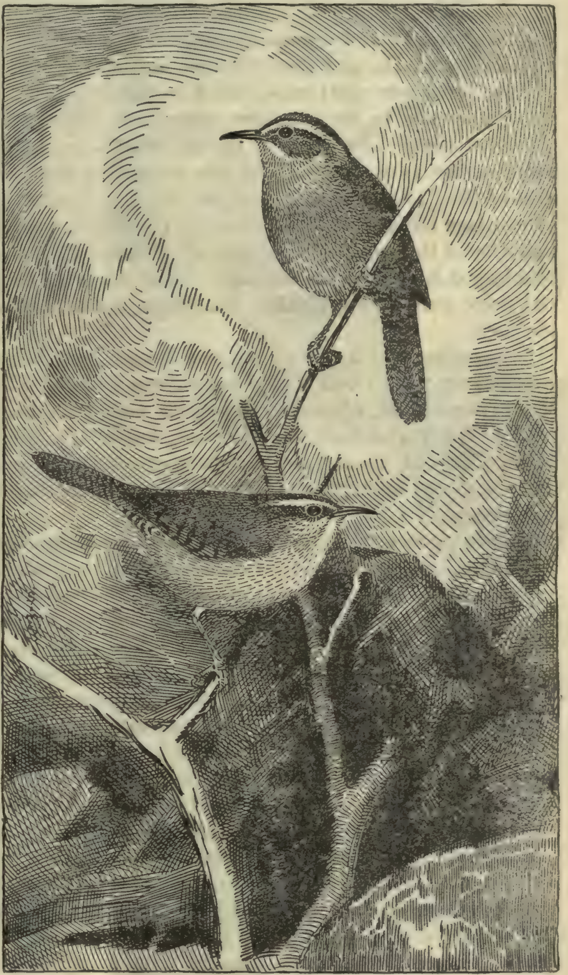

FIG. 3.—Carolina wren. Length, about 5½ inches.

This wren keeps up the reputation of the family as an insect eater, as over nine-tenths of its diet consists of insects and their allies. In this investigation of its food there were examined 291 stomachs, representing every month. Their contents were made up of 94.18 per cent animal matter, nearly all insects, and 5.82 per cent vegetable, chiefly seeds. A very marked uniformity in the diet is noticeable, the winter season showing almost as great a consumption of insects as the summer.

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[1] *Thryothorus ludovicianus.*

Of the animal food, beetles amount to 13.64 per cent, all injurious except a few useful predatory ground beetles (1.71 per cent); two-fifths of these were eaten in December, presumably on account of scarcity of other insects. Many species of snout beetles, or weevils, were identified (4.29 per cent), but the most interesting economically is the cotton boll weevil, 31 individuals of which were found in 18 stomachs. Other beetles, like the 12-spotted cucumber beetle, the striped cucumber beetle, the bean leaf beetle, and numerous so-called flea beetles, all more or less harmful, occur in many stomachs and form 7.64 per cent of the total food.

Ants (4.63 per cent) were found in the stomachs collected every month except September and in very uniform quantities. The greatest consumption was in July (8.81 per cent). For each of the 11 months bees and wasps amount to about the same as the ants. Bugs, with one exception, are the most important item in the diet of the Carolina wren (18.91 per cent), and were eaten every month, with a good percentage for each. The maximum (32.16 per cent) was taken in February. The majority of the insects eaten were of the larger species, as stinkbugs, or soldier bugs, leaf-legged bugs, and leafhoppers. Four stomachs contained the chinch bug and in one there were 5 individuals. Scale insects destructive to oranges were found in one stomach.

Caterpillars and a few moths, the largest item in the food (21.73 per cent), were eaten every month with a good percentage for each. The month of greatest consumption is September, when they constitute more than one-third of the whole food (39 per cent). No special pest was observed, but as the Carolina wren is a small bird the caterpillars are usually so torn to pieces that the species can not be determined; and the moths eaten were so fragile as to be unidentifiable after the process of digestion had begun.

Grasshoppers and crickets, with a few other orthopterous insects, as cockroaches and their eggs, constitute 12.57 per cent of food of the Carolina wren and form a fairly large percentage of the food from July to the end of the year. The average consumption for these months is 19.65 per cent, while that for the first six months is only 5.49 per cent. As with many other birds the month of greatest consumption is August (26.9 per cent).

Flies do not appear very acceptable as food to the wren. None were eaten in January, August, or September, and comparatively few in the other months. The average for the year is a trifle over 3 per cent. The sort mostly taken are the so-called "daddy longlegs," or crane flies.

Spiders are apparently very attractive to wrens in general, particularly to the Carolina wren, which probably finds them when investigating crannies of buildings, piles of lumber, or heaps of brush, as is its habit when looking for nesting sites, or when not pressed by other responsibilities. This wren eats spiders in every month, and in the five months from April to August to the extent of 16.67 per cent for each. In the remaining seven months spiders aggregate 6.16 per cent of the food, an unusual percentage; the average for the year is 10.54 per cent. Most wrens eat spiders more than do other birds, but the Carolina wren excels them all. Millepeds, or thousand-legs, are eaten sparingly throughout the year (2.06 per cent) and none were taken in January, June, or September.

Animals other than insects, as sowbugs and snails, were found in a few stomachs, but constitute only 0.16 per cent. Vertebrate animals would hardly be expected to form part of the diet of so small a bird, but the Carolina wren eats them often. Remains of lizards were found in 14 stomachs, tree frogs in 8, and a snake in 1; totaling 1.92 per cent.

The great bulk of the vegetable food of the Carolina wren consists of various kinds of seeds, mostly of trees or shrubs. Of these, bayberry was found in 20 stomachs, sweet gum in 10, poison ivy in 7, sumac in 4, pine in 2, smart weed and other weeds in 7, and mast (ground up acorn) in 2. Besides these a few stomachs contained pulp which could only be identified as "fruit."

From this analysis of the food of the Carolina wren, it is evident that the farmer and fruit grower have not the slightest cause for complaint against the bird. It eats neither cultivated fruit nor grain, and does not even nest in an orchard tree; but it does feed on numerous injurious insects and enlivens the tangled thickets with its cheerful song for 12 months in the year.—F. E. L. B.

MOCKINGBIRD.[1]

The mockingbird (fig. 4) has always been held in such high esteem for its vocal powers that any attempt to add to its reputation by showing that its food habits also are in its favor may seem superfluous. The title of the mockingbird to rank among economic benefactors has not heretofore been quite clear, however, for, though it does considerable good in the destruction of harmful insects, it is said to eat much fruit, and where fruit raising is an important industry, as in the Southern States, particularly Texas and Florida, bitter complaints are made against it. In Florida, the bird is charged with attacking grapes and oranges, and in Texas it is asserted that figs must be added to the list of fruit it damages.

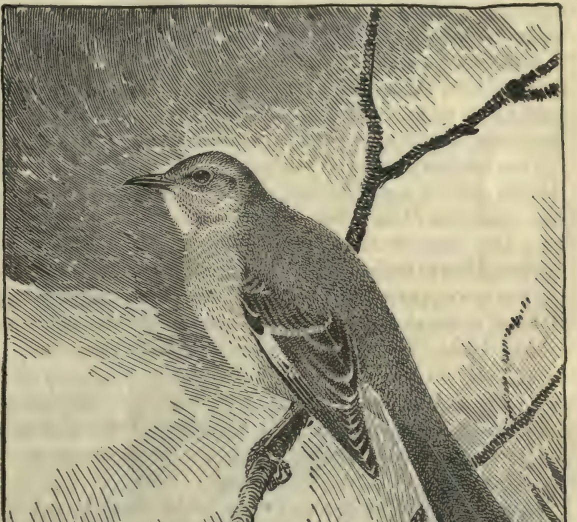

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FIG. 4.—Mockingbird. Length, about 10½ inches.

For the present investigation of the mockingbird's food 417 stomachs were available, and these disclosed 47.81 per cent animal matter to 52.19 per cent vegetable. This is more than twice the proportion of animal food observed in mockingbirds from California. Perhaps the abundant fruit in that section proves too great an attraction for the birds to bother with insects. The stomachs of southeastern birds examined were very evenly distributed over every month. Most of the animal food is taken in May (85.44 per cent). Vegetable food attains its maximum in December and January (86.55 per cent each).

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[1] *Mimus polyglottos.*

The important items in the animal diet are beetles, ants, bees, wasps, grasshoppers, caterpillars, and a few each of several other groups. Useful beetles, mostly predacious ground beetles (3.47 per cent), together with grasshoppers, show that the mockingbird must gather a considerable portion of its food upon the ground. Harmful beetles (7.38 per cent) are of sorts mostly found on leaves of trees, bushes, or plants which are the natural habitat of the mocker. Many of these were weevils, and among them were nine specimens of the cotton boll weevil, in six stomachs. About a dozen stomachs contained remains of the 12-spotted cucumber beetle. Many other species were identified which are nearly as harmful but not so well known.

Ants (4.46 per cent), found in 75 stomachs, again show that the mockingbird goes to the ground for at least a portion of his food. Bees and wasps (3 per cent) are mostly good flyers and must either be taken on the wing or picked from flowers, and it is in the latter situation probably that the mockingbird gets them.

True bugs are eaten so seldom by this bird that the item would not be worth mentioning were it not that one stomach contained remains of that notorious wheat and corn pest, the chinch bug. This insect has probably caused more loss to agriculture than any other in the United States. Although the percentage in the food of the mockingbird is insignificant, any bird that eats this pest deserves honorable mention.

Flies are apparently merely tasted and pronounced not good, for a trace of them is all that stomachs show. Grasshoppers, on the contrary, appear to be the favorite animal food. They are eaten every month and average 14.85 per cent for the year. In July they rise to 43.33 per cent, but in February there is only a mere trace. All the other months make a reasonable showing. Insects of this group captured include true grasshoppers, locusts, and crickets, all harmful and some very much so, as, for instance, the Rocky Mountain locust or grasshopper, which devastated the upper Mississippi Valley a few decades ago.

Caterpillars (9.48 per cent) were found every month in the diet of the mockingbird with a reasonable percentage in all except October. The most were taken in August (23.89 per cent), though nearly as many were eaten in May. Among a host of others, all more or less harmful, was the cotton leaf worm, found in 23 stomachs, and the cotton bollworm, in 2 stomachs. This latter is not confined to the South, but preys upon corn, tomatoes, and other crops all through the central and northern portions of the country. A few insects other than those already discussed were found, but the percentage is insignificant. Spiders were eaten sparingly (less than 2 per cent) in every month except October. A few millepeds, crawfish, sowbugs, and snails also were eaten, but the most singular food consisted of three lizards and a small snake, found in four stomachs.

The predominant vegetable food of the mockingbird is wild fruit. This is eaten every month and totals 42.58 per cent for the year, or more than four-fifths of the vegetable portion. The maximum consumption (76.91 per cent), occurs in October. Wild fruit was found in 246 stomachs, and 76 contained nothing else. Thirty-five species of fruit were identified, and it is probable that more were present but too far digested to be recognized. Those most frequently eaten were the different species of holly, smilax, woodbine, blackberry, pokeberry, elderberry, mulberry, and sour gum.

Domestic fruit (3.35 per cent), the great bulk of which was either raspberries or blackberries, was found in stomachs collected from May to August. Both of these berries grow wild in great abundance over most of the country and those eaten by the mockingbird are as apt to be taken from thickets and briar patches as from gardens. None of the larger fruits were certainly determined, but figs were found occasionally. A few grapes were identified, but these may as well have been wild as domestic. The mockingbird will probably do little harm to cultivated fruits so long as wild varieties are accessible and abundant. The remaining vegetable food was of no great importance, being made up of various weed seeds, sumac seeds of several species—including the poisonous (found in four stomachs)—petals of flowers, and rubbish. No grain of any kind was found.

There appears to be nothing to prove that the mockingbird eats domestic fruits to an injurious extent. It has in general enjoyed about the same place in the affections of the southern people that is held by the robin in the North, and judging by the results of this investigation it well deserves the place.—F. E. L. B.

BROWN THRASHER.[1]

Few birds excel the brown thrasher in sweetness of song, but it is so shy that its notes are not heard often enough to be appreciated. Its favorite time for singing is in early morning, when, perched on the top of some tall bush or low tree, it gives an exhibition of vocal powers which would do credit to a mockingbird. Indeed where the latter bird is abundant, the thrasher is sometimes known as the sandy mocker.

The brown thrasher (fig. 5) breeds throughout the United States east of the Great Plains, and winters in the South Atlantic and Gulf States. It occasionally visits the garden or orchard, but nests in swamps or in groves standing upon low ground, and sometimes builds in a pile of brush at a distance from trees. On account of its more retiring habits it is not so conspicuous as the robin, though it may be equally abundant.

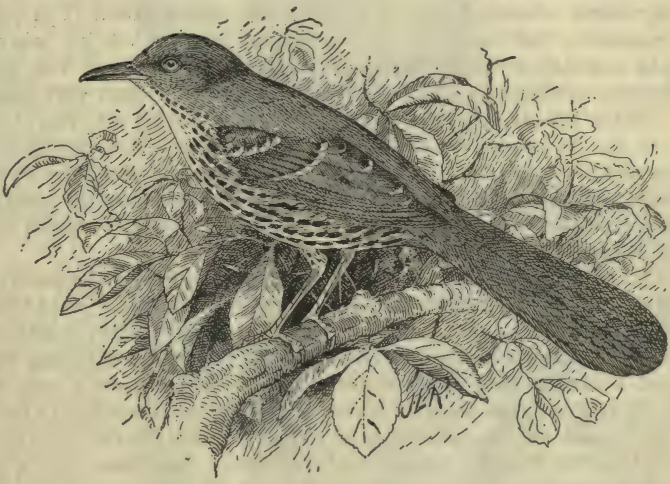

FIG. 5.—Brown thrasher. Length, about 11½ inches. B2145-66

The food of the thrasher consists of both fruit and insects. An examination of 266 stomachs showed 37.38 per cent vegetable and 62.62 per cent animal food, the latter practically all insects.

The most noticeable peculiarity in the food is that no one item is greatly in excess of others, while in the case of the yellow-billed cuckoo, for instance, caterpillars constitute more than half the food. With the thrasher the largest item is made up of beetles (18.14 per cent). A few of these (4.82 per cent) are of useful species, mostly predacious ground beetles. Others (13.32 per cent) are of a more or less harmful character, the great bulk being May beetles and weevils, or snout beetles. Among the latter is the notorious cotton boll weevil, found in six stomachs. May beetles, when in the grub stage, injure roots of grass and other plants. The 12-spotted cucumber beetle, another destructive pest, also was found in many stomachs. Beetles are eaten regularly throughout the year, although a little more from March to June than in other months.

Ants form a surprisingly small percentage of the yearly food (1.38 per cent) when the fact is considered that the thrasher gets most of its food upon the ground, where most ants live. The small destruction of bees and wasps (0.93 per cent) is not surprising, as the thrasher is hardly agile enough on the wing to catch such swift fliers. These three insects, however, are very evenly distributed throughout the year, each month showing a small percentage. Bugs, mostly stinkbugs with a few negro bugs, make up

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[1] *Toxostoma rufum.*

1.54 per cent and are very regularly distributed. One bird taken in Illinois had eaten chinch bugs, but none were found in stomachs from farther south. Flies (1.76 per cent) are evidently not a favorite food of the thrasher, and nearly all of those eaten were taken in November. One stomach secured that month in a Mississippi cotton field was filled with flies except 6 per cent of fruit of "French mulberries"; the bird had probably found a colony of flies hibernating in a crevice and had devoured the whole lot.

Caterpillars (5.95 per cent) stand next to beetles in the thrasher's food, and are taken every month except November; that month, however, is represented by only five stomachs. Grasshoppers and crickets would seem to be very available to the thrasher, as the insects live on the ground, where also the birds get their food; but, unlike the meadowlark, these birds do not esteem grasshopper diet enough to go out in the sunshine to seek it. This food (2.43 per cent for the year) is taken to some extent every month, the maximum (8.5 per cent) in September.

A few insects of other groups are picked up occasionally. In all they amount to only one-fourth of 1 per cent. Spiders (0.58 per cent) are eaten now and then, and myriapods (thousand-legs) to a somewhat greater extent (2.24 per cent), but very irregularly, the maximum (8 per cent) in January. A few miscellaneous animals, like crawfish, sowbugs, snails, and angle worms, make up 1.26 per cent. Bones of lizards, salamanders, and tree frogs (in all, 0.92 per cent) were found in 11 stomachs.

Of the insects eaten by the brown thrasher there is only one class to which exception can be taken—the predacious beetles. That these insects render some service to man is beyond reasonable doubt, though some of them also do injury. Their destruction, then, is not an unmixed harm, but in any case the more numerous noxious insects eaten by the thrasher more than compensate for the useful beetles incidentally destroyed.

The vegetable food of this bird is nearly equally divided between fruit and a number of other substances, of which mast is the most prominent. Wild fruit, the largest item in the vegetable portion (19.94 per cent), was eaten every month in varying quantities, the month of maximum consumption (45.69 per cent) being September; January and February, with dried-up fruit from the last summer's crop, stand next. Altogether about 30 species of wild fruits or berries were identified in the stomachs. Those most eaten are blueberries, huckleberries, holly berries, elderberries, pokeberries, hackberries, Virginia creeper, and sour gum. Some seeds not properly classified as "fruit" were found, as bayberry, sumac—including some of the poisonous species—pine, and sweet gum.

Domestic fruit, or what was called such, was found in nine months, from April to the end of the year, most of it (53.19 per cent) in July. Raspberries or blackberries, currants, grapes, cherries, and strawberries were positively identified by their seeds, but as all of these grow wild, it is probable that much that is conventionally termed domestic fruit is really from uncultivated plants. The aggregate for the year is 12.42 per cent. Most unexpected in the thrasher's diet was mast, principally acorns, although some of it was so finely ground up that it was not possible to tell its exact nature. It is also somewhat a matter of doubt as to just where to draw a dividing line between mast and seeds, so that the proportion of each is somewhat uncertain. In the case in hand the total for the year is estimated at 23.72 per cent. Mast was eaten every month except August, but mostly in fall and winter—November, the month when acorns are abundant and fresh, showing the greatest quantity (57.4 per cent).

Grain (2.57 per cent) was found in the stomachs for six months, but in only February, March, and May were there noteworthy percentages. March shows 12.37 per cent, the other two slightly less. The grain was nearly all corn, with a little wheat, but from the season in which it was taken most of it evidently was waste.

The farmer has nothing to fear from depredations on fruit or grain by the brown thrasher. The bird is a resident of groves and swamps rather than of orchards and gardens, so that it comes but little into contact with the products of husbandry, and does not prey upon them extensively when it does. The useful insects that it eats are amply paid for by its destruction of noxious ones.—F. E. L. B.

CARDINAL.[1]

Vivacity, beauty, and vocal expertness are three outstanding traits of the cardinal, or redbird (fig. 6). Whether the eye is held by the vivid color that suggested the bird's name, or by the active, graceful movements, the raising and lowering of the crest, which when fully erect gives the bird an appearance of such keen attention, or whether the ear is charmed by the rich and varied song, the impression produced is one of extreme pleasure.

Though somewhat shy, the cardinal does not entirely avoid the vicinity of homes. However, it prefers more secluded resorts. Shrubbery is its chosen haunt, the more tangled the better. Here the nest is built and the young reared, and here they spend most of their days. Higher trees are usually sought only under the inspiration of song.

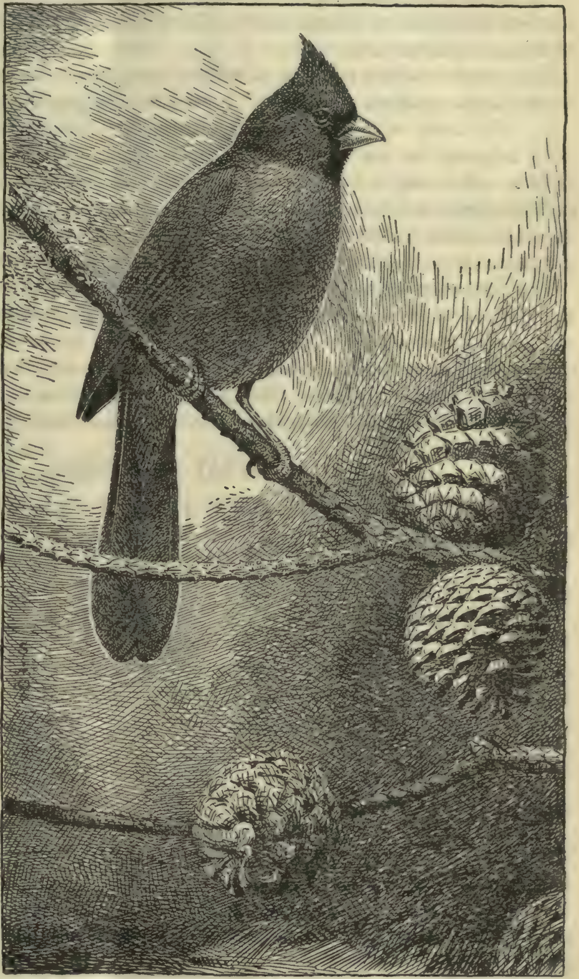
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FIG. 6.—Cardinal. Length, about 8¼ inches.

Viewed from the economic standpoint the cardinal deserves favorable comment, as it does for its other high qualities. Its food is composed of about 29 per cent animal matter and 71 per cent vegetable. Among the insects eaten are a few that are beneficial, but at most not more than 2 per cent of the cardinal's food, probably less, consists of useful insects, while twelve times as much is made up of injurious species. Caterpillars are greatly relished, and among those discovered in the food were three pests of the cotton crop, namely, the cotton worm, the bollworm, and the cotton cutworm. Ninety-six of the last-named species were eaten by 31 cardinals from Texas cotton fields. Other caterpillar pests eaten are the purslane sphinx, zebra caterpillar, and codling moth.

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[1] *Cardinalis cardinalis.*

Grasshoppers, together with true bugs, form more than one-tenth of the total food. These groups of insects comprise many injurious forms of which the cardinal takes due toll. Especially commendable is the destruction of scale insects, of which several different species were identified from the stomachs of 21 redbirds.

Beetles comprise more than a tenth of the whole diet. Among them, weevils are predominant. The acorn weevils, clover weevils, and billbugs, all injurious forms, are freely eaten, and the cotton boll weevil occasionally. Vine chafers of various species, the southern fig eater, and rose chafers are among other injurious beetles destroyed. Click beetles, cucumber beetles, strawberry root borers, plum and locust leaf beetles also are devoured by the cardinal. The bird has a record for feeding on many of the worst agricultural pests.

The vegetable food consists chiefly of weed seeds, but wild fruit and grain also are eaten to some extent. The grain, however, is largely waste, as it is taken only in winter. Wild fruit, or rather the seeds of wild fruit which usually are extracted and the pulp rejected by the redbird, composes about one-fourth of the total subsistence. Wild grape seeds are favorites, but those of dogwoods, blackberries, hackberries, smilax, cherries, blueberries, elderberries, pokeberries, and juneberries, and the fruit of prickly pear, sumac, holly, redhaw, passion flower, Mexican mulberry, and palmettos also are eaten. Little, if any, attention is paid to cultivated fruits.

Most important among the items of vegetable food is weed seed. This forms more than a third of the total food. Seeds of smartweeds and bindweeds rank first in preference, and the seeds of the following troublesome weeds are freely eaten: Foxtail, bur, cockspur, crab and yard grasses, dodder, dock, sow thistle, plantain, tumbleweed, nail grass, lamb's-quarters, chickweed, sticktight, partridge pea, and buttonweed. The redbird occupies an important place among birds devouring weed seeds.—W. L. M.

GRAY GROSBEAK.[1]

The gray grosbeak, or parrot-bill, is about the same size as the cardinal, closely resembles that bird in song and general demeanor, and has similar nesting habits. Moreover, it frequents the same kind of country and is resident wherever found. In appearance, however, it is quite dissimilar.

In strong contrast to the glowing hue of the cardinal the general color of both sexes of the parrot-bill is light gray. The wings, tail, and long crest are suffused with dark red and the wings are lined with rose. This color also surrounds the beak of the male and extends over throat and breast in an irregular patch. The beak is yellowish and is very curiously modified, being short, thick, strongly curved, and apparently of great power.

The gray grosbeak comes into the lower half of Texas, not reaching, however, the extreme eastern part of the State.

Seventy-four stomachs of gray grosbeaks from Texas have been examined, 59 collected in August and 15 in September. Vegetable matter averages 71.19 per cent of the contents and animal matter 28.81 per cent.

Grass seeds constitute an average of 53.09 per cent of the total food of the birds examined, or more than five-sevenths of the vegetable food alone. Most important among them are foxtail and bur grass, which together amount to 43.59 per cent of the food. Since these grasses are among the most pernicious of weeds, the parrot-bill is more than welcome to all their seeds it desires.

The seeds of other grasses eaten are important, furnishing 9.51 per cent of the bird's subsistence. Among these are witch and crab grasses, most species of which are weeds, and yard or wire grass. Seeds of a spurge contribute 9.81 per cent of this grosbeak's fare, and other weeds, including bindweed, lamb's-quarters, tumbleweed, sunflower, carpetweed, nightshade, vervain, and mallow compose 6.13 per cent.

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[1] *Pyrrhuloxia sinuata texana.*

While the parrot-bill consumes a smaller proportion of animal matter than the cardinal, it selects about the same things, the principal items being grasshoppers, caterpillars, and beetles. Neither parasitic hymenopterans nor predacious beetles were found in the stomachs examined, a showing much to the bird's credit. Only one useful insect had been eaten, it belonging to a queer neuropteroid genus, the members which are rare. They are predacious when adult, and when young are parasitic in the egg sacs of spiders.

The remaining animal food is composed of injurious species, many of them important pests. Beetles constitute 4.66 per cent of the food, weevils alone being 3.42. Of greatest interest among the latter is the cotton boll weevil, the most serious agricultural pest of recent years. While the gray grosbeak does not feed upon it regularly, nevertheless the habit of picking it up when occasion offers is highly commendable. Leaf beetles, bronzy wood borers, and long-horned beetles, all of which are destructive to forest and orchard trees, also were found in stomachs of this species

Beetles, as a whole, are exceeded in the food of this bird by caterpillars, the latter constituting 10.32 per cent of the diet. One of the species identified—the cotton worm—has long been known as a great pest throughout the Southern States, and in certain years has caused a decrease in the crop of a quarter of a million bales, valued at $25,000,000. Fourteen of the 74 gray grosbeaks examined consumed cotton worms, which averaged 39.1 per cent of their food. As many as 18 caterpillars were found in a single stomach. Another caterpillar enemy of the same crop—the cotton cutworm—also is freely devoured.

As beetles are less esteemed than caterpillars by the gray grosbeak, so also are the latter less liked than orthopterous insects. This group contributes 11.52 per cent of the total food, and includes both long and short-horned locusts and their eggs, 7 or 8 grasshoppers sometimes being secured by a single bird. True bugs, comprising stinkbugs and their eggs, cicadas, leafhoppers, and lantern flies come to about 1.5 per cent. All these insects are injurious and the bird does a service by feeding upon them.

One parrot-bill was bold enough to swallow a large hornet. A few ants also were eaten, and these, together with spiders and snails, complete the list of animal food taken. Although this grosbeak is not conspicuously insectivorous, almost all the insects it eats are injurious.

The data at hand are insufficient to determine finally the exact economic status of the bird, but it may be stated with confidence that the gray grosbeak is almost entirely beneficial.—W. L. M.

PAINTED BUNTING.[1]

The male painted bunting (fig. 7) is one of the most brilliantly colored birds of the United States. The upper part of the head and neck are shining purplish violet, the middle of the back yellowish green, wings and tail purplish blue, and underparts and rump vermilion. The female is dark green above and yellowish beneath.

This little jewel has not failed to attract popular attention and in consequence has received a variety of common names. In Louisiana the French speaking people have called it nonpareil (unequaled), and le pape (the pope). The last name has been contracted to pop and varied as red pop. Spanish speaking citizens know the bird as mariposa (butterfly), and in English the bird has variously been named painted bunting or finch, paradise finch, Mexican canary, and Texas canary.

The painted bunting is not only distinguished in appearance, but also is one of the most pleasing songsters among the finches. It is a persistent vocalist, and this characteristic, in addition to its beauty and activity, makes it a most desirable species for the vicinity of homes. Fortunately the bird is not averse to proximity to man, and its preference for shrubbery further adapts it to living about dooryards and gardens. The nest, though usually placed low, is well concealed, and the eggs number three to five.

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[1] *Passerina ciris.*

Few complaints have been lodged against the painted bunting on the score of its food habits. It is said to eat rice at times, to peck into figs and grapes, and to bite off the tips of pecan shoots. In no case that has come to notice, however, has it been charged with doing serious damage. Certainly no such charge is supported by the investigations of the Biological Survey, for no product of husbandry has thus far been found in any of the stomachs, 80 of which have been examined, all collected in Texas in July, August, and September. Averages for the July and August material only are here presented. Animal matter composed 20.86 per cent of the contents of these stomachs, and vegetable matter 79.14 per cent. Of the former, 2.48 per cent was made up of weevils, mostly cotton boll weevils. All insects of this group are destructive, but none more so than the notorious cotton boll weevil, and this species had been eaten by 18 of the 80 nonpareils examined.

Another enemy of the cotton crop attacked by these brightly colored little birds is the cotton worm. This insect was preyed upon to the extent of 3.14 per cent of the total food of the 80 painted buntings examined. Other insects eaten include grasshoppers, crickets, click beetles, leaf beetles, caterpillars, true bugs, and small hymenopterans. A few spiders and one snail also were taken.

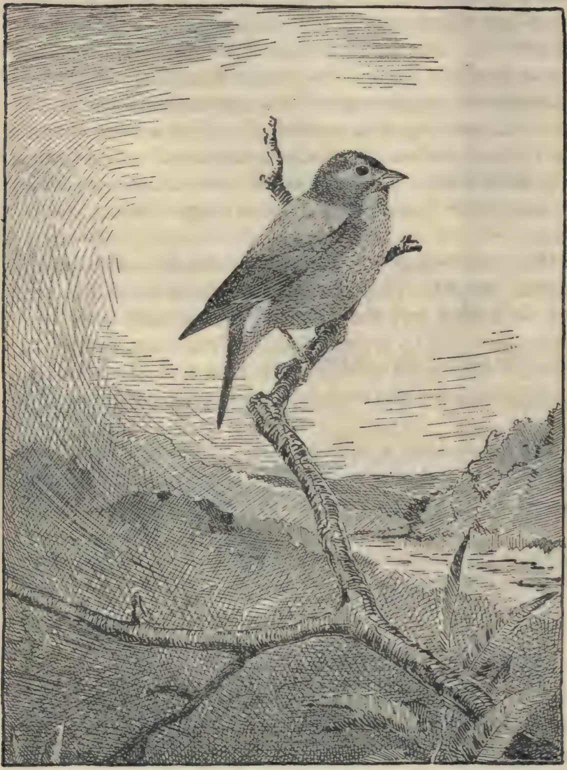

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FIG. 7.—Painted bunting. Length, about 5¼ inches.

The vegetable food is remarkable in consisting very largely of a single item—the seeds of foxtail or pigeon grass. This is one of the worst weeds in the United States. The 80 painted buntings made over two-thirds (precisely 67.03 per cent) of their total food of its seeds. The seeds of other grasses composed 5.88 per cent of the food, grasses alone thus furnishing over nine-tenths of the vegetable portion. The other vegetable matter eaten consists largely of seeds of such weeds as amaranth, mallow, sorrel, and nail grass.

To sum up, practically all of the vegetable food of the painted bunting is of weed seeds, two-thirds of it being the seeds of foxtail grass, one of the worst weed pests. The animal food also is composed almost exclusively of injurious species, more than a fourth of it consisting of the two greatest pests of the cotton crop—the cotton worm and the boll weevil.—W. L. M.

COMMON CROW.[1]

Though not possessing the proverbially bad reputation of its kin of the Northern States, the crow (fig. 8) of the South is well known in a large part of the area of which this bulletin treats. Throughout the coastal region east of Texas it is intimately associated with its maritime relative, the fish crow,[2] and in winter these two have much the same food habits.

The series of 108 stomachs available for examination, while too few to show accurately the food habits of the crow over so large an area, has verified much of the information gained from field observation. The food of the crow of the South is much like that of its northern relative, such differences as are observed being due to the relative abundance of certain food items in the two areas. The southern crow has many of the virtues of the northern bird, and, so far as the evidence at hand shows, certain corvine failings, as nest robbing and injuring sprouting corn, seem less pronounced.

Examination of stomachs revealed 31 per cent animal food and 69 per cent vegetable. Insects comprised a little less than a fifth of the yearly sustenance, and were made up of many of the common pests, as May beetles and their larvæ (white grubs), which were eaten in every month save two; weevils of several kinds; grasshoppers (nearly 5 per cent); and several species of caterpillars. Such beneficial insects as predacious ground beetles and bugs and parasitic hymenopterans formed less than 2 per cent.

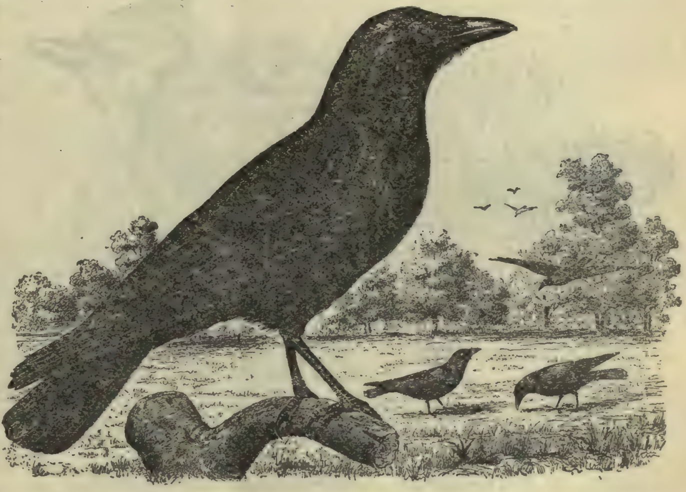

FIG. 8.—Crow. Length, about 19½ inches.

Crustaceans, by far the largest part of which were crawfish, constituted an important food item (7.4 per cent). These creatures in some sections of the South are the cause of considerable damage, especially to corn and cotton. A few mollusks, amphibians, and fish (about 4 per cent) indicate the aquatic feeding habits of these birds. Fragments of the shell of a hen's egg found in one stomach supply the only evidence of that objectionable trait of which the northern crow is so frequently accused. No remains of wild birds or their eggs were found.

In the vegetable food, corn and wild fruits stand out prominently. The former constituted about a fourth of the yearly subsistence, but a large portion was taken in winter when it must have been secured from outstanding shocks or picked up as waste. Such wild fruits as sour gum, poisonous and nonpoisonous sumacs, pokeberry, blackberries, greenbrier, and the like composed nearly a third of the food, and were so prominent probably because of the great abundance of many of these plants throughout the South. Grain, other than corn, and a little cultivated fruit also were taken.

Field observation has shown that certain other items not revealed by laboratory examination enter into the diet of the southern crow. Watermelons are frequently damaged, and small gardens have suffered losses in peas, strawberries, and peanuts. Growers of pecans also have entered complaints against the crow. In many sections the bird has been credited with being a most potent disseminator of live-stock diseases, especially hog cholera. While he may be one of many distributors of these diseases, ultimate remedies depend upon close attention to sanitation and quarantine rather than the destruction of all possible carriers. As a carrion eater, the crow renders the farmer an important service, especially in the South.

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[1] *Corvus brachyrhynchos.*

[2] *Corvus ossifragus.*

In view of the fact that corn pulling may be largely prevented by the use of deterrents, as coal tar upon the seed; that loosely made corn shocks, left standing long after the corn should have been properly stored, are a constant attraction for these birds; that damage to poultry and their eggs may be largely obviated by the proper housing of nesting fowls and the screening of chicks; and that much can be accomplished by scarecrows and other frightening devices, it appears that the legislation regarding the crow at present in force in the Southern States is satisfactory. Absolute protection is not afforded in any of these States. This allows the crow to be held in check when doing damage, yet the absence of extensive campaigns of destruction permits it to continue unmolested, in large measure, its good work in the destruction of insect pests in spring and summer.—E. R. K.

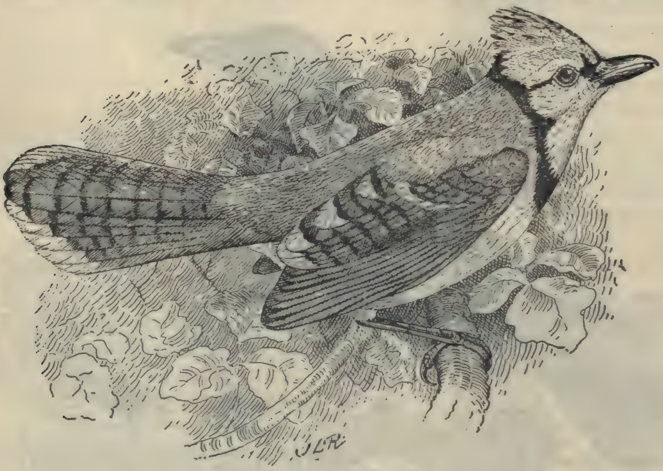

FIG. 9.—Blue jay. Length, about 11¾ inches.

BLUE JAY.[1]

In the Southern States the blue jay (fig. 9), or "jay-bird" as he is more familiarly known, is a resident the year round, and in winter his numbers are swelled by migrants. Stomach examination shows that he possesses essentially the same food habits as his relatives in the North, while such differences as do occur are somewhat in favor of the southern bird. Complaints from agriculturists and sportsmen appear to be less frequent and severe in this area, while bird lovers have had less to say regarding the jay's habit of nest robbing, though this may be in part due to the fact that the movement to foster small insectivorous and game birds has not attracted so much attention here as in some sections farther north.

Examination of 184 stomachs indicates that animal food forms 31.9 per cent and vegetable 68.1 per cent of the total. Insects make up 26.5 per cent of the yearly sustenance, an increase of about 4.5 per cent over the northern bird; this is the strongest point in favor of the southern jay, especially since in this food are many of the most destructive pests, foremost among which are caterpillars and grasshoppers, in about equal quantity. Common articles in the blue jay's diet are scarabæid beetles, including May beetles, euphorias, and other related species, all of which, in one stage or another of their development, are highly destructive to vegetation. In May, when the first of these are abundant, they comprise nearly three-tenths of the food. About wood lots the jay renders particularly valuable service in his choice of insect food.

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[1] *Cyanocitta cristata.*

Important elements include both the flat-headed and round-headed wood borers, as well as numerous weevils, those feeding on pine predominating. Beneficial insects, including predacious ground beetles and bugs, and parasitic hymenopterans comprise about 9 per cent of the yearly food. The jay's liking for snails, which furnish an ample supply of animal matter at times when insects are scarce, appears to be akin to the southern crow's preference for crawfish. A few batrachians (toads and frogs), lizards, and even fish help out when hunting is not at its best. Of the 184 stomachs examined only one contained the egg of a small bird; shells of hen's eggs occurred in 13 of these, but as the jay is given to rummaging about rubbish piles, the source of some of this material may be thus explained.

A consideration of its vegetable food discloses evidence unfavorable to the southern blue jay. Of cultivated fruit and corn he takes considerably less than the northern bird, but on the latter food he lays heavy toll just at the time when the grain is in the roasting ear and ripening. In fact, in August, corn closely associated with the silk torn from the top of the ear was found in 11 of 15 stomachs, forming over 58 per cent of the monthly food. This item was also well represented in stomachs collected in July and September. But by far the most popular article of diet of the southern jay is mast, which composes nearly 46 per cent of the yearly food, and in January, when other food is scarce, runs as high as 84 per cent. Complaints against the bird on this score are few as yet, but this liking for mast may lead him into trouble with growers of cultivated nuts—pecans, for instance.

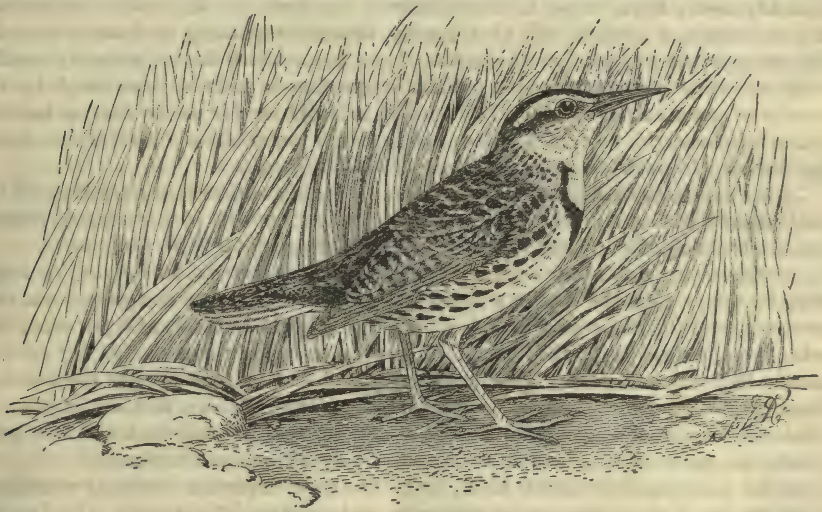

FIG. 10.—Meadowlark. Length, about 10¾ inches.

While there may be possibilities of the southern jay becoming troublesome locally, at present he can not be considered a serious menace to agriculture. His insectivorous diet during spring and summer, which includes many destructive species, more than compensates for the losses inflicted upon cornfields later in the season, or upon isolated orchards of cultivated nuts.—E. R. K.

MEADOWLARK.[1]

The meadowlark (fig. 10) is a familiar bird of grassland throughout the whole United States, though less abundant in the Southwest. Alike on eastern meadows, western prairies, and southern savannas, its clear pipe may be heard in spring announcing the return of the season of procreation and growth. For its home it chooses level, slightly undulating land free from trees, and, if possible, with a supply of water near at hand, for the meadowlark delights in a clear running brook for drinking and bathing. Its nest is built on the ground among the dead herbage of the last year's growth, and is usually overarched to protect the eggs and the sitting bird from the weather, and is often so completely buried from sight as to defy detection by the most skillful searcher. The bird's preference for unmown fields covered with what farmers call "old fog" has given rise to the name of "old-field lark," by which it is known in many places.

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[1] *Sturnella magna.*

The great bulk of the species is migratory from the Northern States, but from the latitude of Pennsylvania southward the bird is found throughout the winter, its numbers somewhat increasing farther south.

As a rule, farmers have made little complaint of this bird, but a Georgia farmer says that meadowlarks and crows do much harm to his corn and oats when first planted; that they seem to pull up the sprouting seed for the fun of it, as they do not eat half what they pull up; and that the meadowlarks are much more destructive than the crows. A Tennessee farmer reports that the meadowlarks eat clover seed (presumably newly sown) to an injurious extent. As these are the only complaints of any consequence against this bird, among thousands relating to damage done by others, it would appear that the habits of the meadowlark do not seriously conflict with the interests of the farmer. This supposition is fully substantiated by the results of examination of the bird's food, and it is still further shown that, so far from being injurious, the meadowlark is one of the most useful allies of agriculture, standing almost without a peer as a destroyer of noxious insects.

In the laboratory investigation 890 stomachs were examined, representing all the southeastern States, and every month of the year. Analysis of the contents showed animal food, chiefly insects, 78.12 per cent, and vegetable, 21.88 per cent.

As illustrating this bird's vigilance in its search for insects, an instructive lesson may be drawn from the food of a group of six birds taken when the ground was covered with snow. The stomach having the least insect food contained 8 per cent; that with the most had 95 per cent; and the average for the six was over 47 per cent, or nearly half the total food. The insects consisted of beetles of several species, true bugs, grasshoppers, crickets, a few wasps, caterpillars, spiders, and myriapods. It thus seems evident that insects are essential to the diet of this bird and that great efforts are made to obtain them even under very adverse circumstances.

Of the insect food of the 890 birds, by far the most important elements were grasshoppers, long-horned or green grasshoppers, and crickets (27 per cent). In January they form more than 9 per cent of the total food, and increase rapidly until October, when they reach the surprising total of 56 per cent. During the succeeding months they decrease slowly, and in November still constitute 40 per cent. It is extremely doubtful if any other bird will be able to show a better record for the destruction of grasshoppers. One stomach examined contained 37 individuals; but it should be borne in mind that the birds that form the subject of this paper were not collected from any region specially infested, but were gathered from all parts of the Southern States, and of the whole number, 466 contained grasshoppers.

Beetles of many species stand next to crickets and grasshoppers in importance, and constitute nearly 18 per cent of the annual food. One of the most harmful of these is the family of the May beetles or leaf chafers, the average consumption of which amounts to about 9 per cent for the year, and the greatest, 28 per cent, in May. Most of these are dung beetles, but remains of the well-known May beetles were found. Snout beetles, or weevils, form a small but very constant element of the food (about 4 per cent). Beetles belonging to about a dozen other families collectively constitute about 3 per cent of the whole food. Of importance in considering the diet of every bird is the extent to which it eats predacious ground beetles. From its habits the meadowlark might be expected to feed largely upon these beetles, as they live upon the ground for the most part and are very abundant. Examination shows that these insects constitute somewhat more than 11 per cent of the food of the year. When it is considered how exclusively the meadowlark feeds upon the ground, this is certainly a very moderate exhibit and would seem to indicate that the bird does not especially seek for these beetles but simply eats such as fall in its way.

True bugs are eaten with fair regularity by this bird throughout the year, averaging 3 per cent of the food of the season. The greater number are of the family of stink-bugs, some of whose members are familiar (by taste) to many who have eaten raspberries from the vines; these will wonder at the taste of a bird that can habitually eat such highly seasoned food. Three specimens of the notorious chinch bug were found, and it is gratifying to know that the meadowlark will eat this insect which has done millions of dollars damage in this country.

Caterpillars, or the larvæ of butterflies and moths, form a very considerable portion (nearly 13 per cent) of the food of the meadowlark, but, as with most other birds, the adults are rarely eaten, only 3 small moths having been found in as many of the 890 stomachs. Caterpillars were found in every month, and even the stomachs taken in December show over 2 per cent. The maximum (28 per cent) is attained in May.

Spiders and myriapods (thousand-legs) are eaten freely, and aggregate nearly 3 per cent of the food. Other insects eaten include flies, found in a few stomachs; a dragonfly in one; an earwig in one; and a common cattle tick in one. Snails or fragments of their shells were found in seven stomachs, sowbugs in two, a small crustacean in one, and the bones of small frogs or toads in three. These last were from stomachs taken in Florida and do not seem to be a favorite food.

The vegetable food of the meadowlark comprises 21.88 per cent of the total, and may be roughly divided into fruit, grain, and weed seed. Fruit is mostly of wild species and amounts to less than 2 per cent. Grain of three kinds—corn (the favorite), wheat, and oats—constitutes a little less than 9 per cent, and was mostly taken in winter, showing conclusively that it was waste. No sprouting grain was found. Weed seeds, chiefly ragweed, barngrass, smartweed, sorrel, mustard, amaranth, and gromwell (about 7 per cent), like the grain, were mostly eaten in winter. In the analysis of the stomach contents clover seed was especially looked for, as the meadowlark has been accused of eating this to an injurious extent, but it was found in only six stomachs and only a few seeds in each—some with only one.

Stomach analysis does not indicate that grain is preferred to other seeds. The quantity of each taken is practically the same and in such a grain-raising country as this it can not be urged that this food is less easily obtained than the seeds of weeds. When meadowlarks collect in flocks, as they sometimes do, they may do some damage to grain, but at the time of the harvest of wheat and oats they are not thus congregated, and the stomach records show that at that season practically none of these grains were found, it being the time when insects were most abundant and constituted nearly the whole food.

Unfortunately for the meadowlark, its body is plump and its flesh well flavored, and as it is easily killed the temptation is too great for some persons to resist. But it is most emphatically a case of "killing the goose that lays the golden eggs." The small portion of food that the creature's body yields is as nothing compared with the good the bird does when alive. The tendency to treat the meadowlark as a game bird is far too general, and every farmer on whose land it is found should rigidly protect it and allow it to breed undisturbed. When its numbers have so far increased as to render it dangerous to crops will be soon enough to begin the thinning-out process, but that day is still far distant in most parts of the country.—F. E. L. B.

BOAT-TAILED GRACKLE.[1]

The boat-tailed grackle (fig. 11), the largest of the blackbirds in the United States, inhabits the South Atlantic and Gulf States from Virginia to Texas but is not found at any great distance from the coast. Little has been written concerning its food habits, but Audubon, whose account is apparently the best, says:

> The food of this species consists principally of those small crabs called "fiddlers," of which millions are found along the margins of the rivers and mud flats, as well as of large insects of all kinds, ground-worms, and seeds, especially grains. * * * In autumn, while the rice is yet in the stack, they commit considerable mischief by feeding on the grain, although not so much as when it is in a juicy state, when the planters are obliged to employ persons to chase them from the fields.[2]

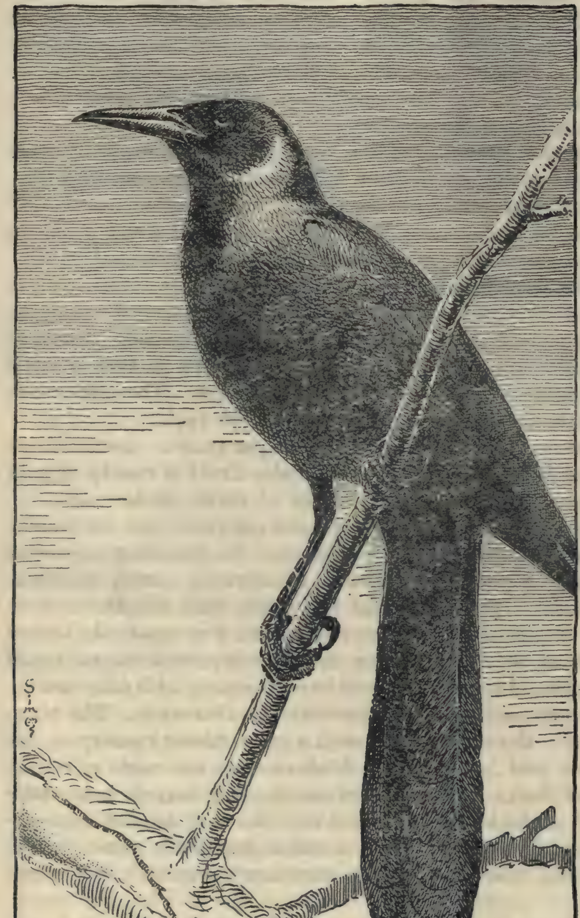

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FIG. 11.—Boat-tailed grackle. Length, about 16 inches.

In the investigations made by the Biological Survey there have been examined 247 stomachs from Florida, Alabama, Mississippi, Georgia, and Texas, representing every month in the year. The food consists of 47.45 per cent animal matter and 52.55 per cent vegetable. The former is made up of insects and crustaceans, with a few lizards, toads, frogs, small mammals, etc. Crustaceans make up more than a third of the animal food (16.81 per cent of the total) and consist of crawfish, crabs, and shrimps, a true seashore diet. No insects appear to be specially sought. Predacious beetles (3.23 per cent) are taken mostly in fall, and other beetles are found to some extent, but no family is conspicuous. Grasshoppers are eaten in July and August (34.47 and 30 per cent, respectively) but very few in any other month. The average for the year is 7.76 per cent. Six birds taken in Texas in September are worthy of special mention from the fact that they had all eaten cotton bollworms in quantities varying from 26 to 93 per cent of the food. A few other insects and remains of small vertebrates are frequently found in the stomachs, but do not form important elements.

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[1] *Megaquiscalus major.*

[2] Ornith. Biog., II, 504, 1835.

Grain (35.65 per cent), all but a mere trace of which is corn, composes part of the food of every month except May—the only stomachs collected in this month came from a rice field near Savannah, Ga. In each month except May and November corn constitutes more than half the vegetable food. October shows the greatest quantity (71 per cent of the total food), but as only five stomachs were taken in this month this result can hardly be regarded as a fair average. The pulp of some large seed or nut, not otherwise identified, was next in importance to corn. Remains of figs in several stomachs and wild grapes in one, indicate that fruit is eaten, though sparingly. No weed seeds were found.

It is thus evident that no very salient points in favor of the boat-tailed grackle have come to light. In its insect food it has no very pronounced preferences, and while it does not cause great havoc among useful insects, it does not prey extensively upon harmful ones. In common with most other land birds, it eats grasshoppers freely in July and August, and shows a taste for caterpillars as well. The animal food it decidedly prefers is small maritime crustaceans, and these, so far as the interests of agriculture are concerned, are entirely neutral. In its vegetable diet, the bird certainly does not commend itself to the agriculturist. Its preference for corn is very marked and shows no variation with the change of season. That it visits the growing crop for its supplies is evident from the fact that much of the corn found in the stomachs during early summer is "in the milk." In any locality, therefore, where this grackle is very abundant it must almost necessarily be harmful to the corn crop without rendering any well-defined service in return.—F. E. L. B.

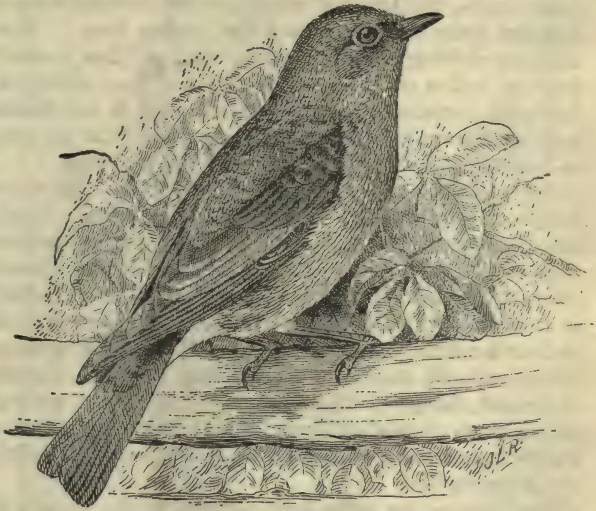
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FIG. 12.—Bluebird. Length, about 7 inches.

BLUEBIRD.[1]

Typical of all that is pleasing in bird life generally, the bluebird (fig. 12) is especially cherished wherever it is found, and on esthetic grounds alone is carefully protected. It ranges in the breeding season throughout the United States east of the Rocky Mountains, and remains in winter as far north as the southern parts of Illinois and Pennsylvania. It is one of the most domestic of our wild feathered friends and readily takes possession of the box erected for its accommodation where it can be safe from cats and other prowlers, or utilizes crannies of farm buildings for its nest; its original homes, however, were in such places as deserted woodpecker-holes or cavities in old stumps. These birds are usually abundant wherever found and their numbers are maintained by the rearing of two and frequently three broods a year, with from four to six young in each. The food supply for such large families may well concern the farmer, and he will be interested to learn what these birds relish most.

For studying the food of the bluebird 244 stomachs from the Southeastern States were available, and the contents, 58.51 per cent animal food and 41.49 per cent vegetable, well demonstrate that the bird is as deserving of protection on economic grounds as it is for esthetic reasons.

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[1] *Sialia sialis*.

In the animal food the largest portion is made up of orthopterous insects (grasshoppers, crickets, and katydids), totaling 20.53 per cent for the year. Most insects of this group are harmful and at times very destructive. Second in importance in the diet are beetles (18.79 per cent), made up in part of useful ground beetles (10.38 per cent of the total food), but in this item also are May beetles (3.9 per cent), weevils, or snout beetles (1.13 per cent), and miscellaneous related forms (3.38 per cent). The useful beetles are sometimes eaten in such numbers as to detract from the esteem in which the bluebird is held, the month of May, for instance, charging them against the bird to the extent of 36.61 per cent of the food, and every month recording them in such quantities as to indicate that they are very palatable to the bluebird. Few birds exceed this record of destruction of useful beetles, but it must be remembered that for the year they form only about one-tenth of the food, and that the remaining food shows that insects as a whole are attacked so impartially that the balance of nature is not disturbed, and while one kind of insect life is not exterminated another is not allowed to become superabundant; grasshoppers, for instance, enter the food of the bluebird about in proportion to their abundance.

The group third in order of importance in the animal food contains the many forms of caterpillars, including a few moths (9.59 per cent). Chief among these are the owlet moths, the larvæ of which are the well-known cutworms, but there are also included hairy caterpillars and the "yellow bear." The rest of the animal food is made up of flying insects, as wasps, bees, and flies, in small quantities, for the bird is not very active on the wing; of ants and bugs, among which latter stinkbugs predominate; remains of chinch bugs, detected in one stomach; a few spiders (2.47 per cent); still fewer myriapods, or thousand-legs (1.23 per cent); a mere trace of sowbugs and snails; and a few bones of lizards and tree frogs.

The vegetable food consists largely of fruit obtained from pastures, swamps, and hedgerows, rather than from gardens and orchards. Practically all the domestic fruit taken was secured in June and November, and the only cultivated species identified were cherries and raspberries or blackberries. In December, wild fruit forms two-thirds of the monthly food, but this item decreases gradually each month, and in May no fruit of any kind is taken. The yearly average is about a third of the total food. As fruit is taken chiefly in winter, it follows that it is eaten to tide the bird over until insects are again abundant, partly taking the place of seeds in the winter diet of birds in general, though seeds, too, are occasionally and sparingly eaten by the bluebird. Among them are seeds of sumac of both harmless and poisonous kinds, bayberry, and a little indeterminate vegetable refuse and rubbish, together averaging 7.21 per cent of the yearly food.

The bluebird has never been accused, in the writer's knowledge, of objectionable habits, and cultivated crops are not only safe from its attacks, but are benefited by its ridding them of an overabundance of harmful insects. In spring and early summer, when berries and small fruits are at their best, the bird subsists upon insects to the extent of five-sixths of its food. Its fruit-eating period is from late fall to early spring, when insects are scarce and waste fruit available. The point that has been urged against the bird, its destruction of predacious beetles, is a harmful trait more apparent than real, inasmuch as its record on all other lines is absolutely in its favor. Field observation and laboratory analysis of the food fully justify the high esteem in which the bird is held, and there is not the slightest excuse for persecuting it or withdrawing from it the smallest degree of protection.—F. E. L. B.

CAROLINA CHICKADEE.[1]

The Carolina chickadee (fig. 13) ranges through the southern portion of the United States from the Atlantic to the Rockies and north to the Ohio River and to some extent beyond. Its nest is built in hollow trees or posts, or in boxes set up for its special accommodation. A bird of forests and groves, it is not found on treeless areas, and does not often alight upon the ground. From this it follows that its food is mostly of the kind that can be taken on trees or bushes, and, therefore, excludes such ground-inhabiting insects as ants and grasshoppers.

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[1] *Penthestes carolinensis.*

The study of the food habits of the Carolina chickadee is based upon an examination of the contents of 210 stomachs collected in the Southeastern States. The food consisted of 71.94 per cent animal matter and 28.06 per cent vegetable, the former being made up of insects and spiders with a few sowbugs, found in one stomach, and the latter of berries and several kinds of seeds.

Beetles, being rather terrestrial in habit, escape the chickadees to some extent, forming only 3.67 per cent of their food. Nearly half of these were snout beetles, or weevils, of which practically all species are more or less harmful and many are pests. The predacious ground beetles apparently elude these birds completely, for not a trace of one was found in any of the 210 stomachs.

A few ants were taken in the months from February to June, except May, but the average for the year is only 0.36 per cent. Bees and wasps (4.48 per cent of the food of the year) were taken oftener and more regularly. The month of greatest consumption was February, which would appear to be rather early for bees and wasps to be out extensively, and March stands next.

Bugs seem to be a favorite food in the four months from April to July, during which the great bulk is eaten. The average for these months is 15.13 per cent, but for the whole year it is only 5.68 per cent, as bugs were eaten in only three of the other eight months and then but sparingly. This item of food is made up of stink-bugs, shield bugs, leafhoppers, tree-hoppers, plant lice, and scales. While no special pest was noted, nearly all of these are harmful and especially the last two, of which there are hundreds of species and nearly every plant has its own peculiar form.

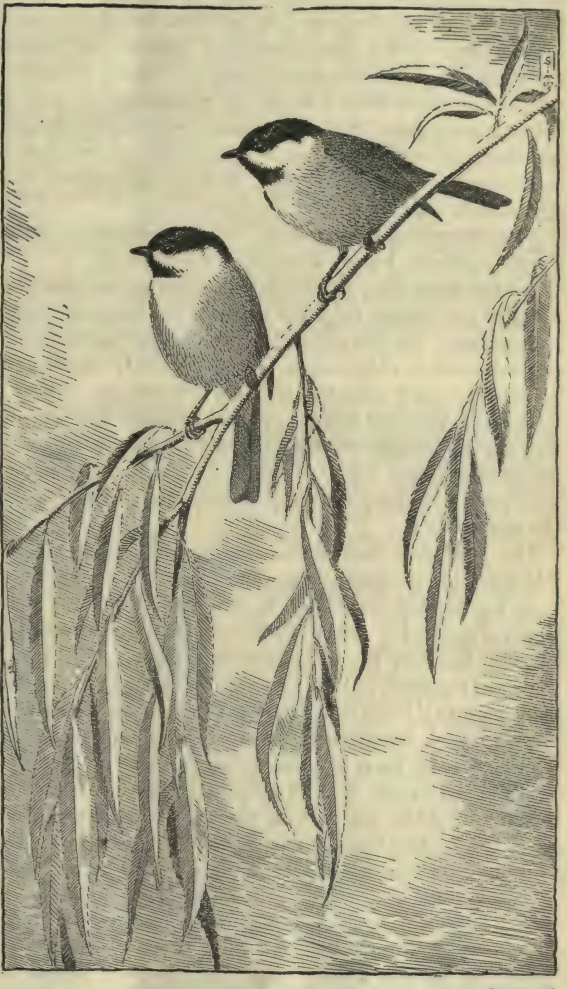

FIG. 13.—Carolina chickadee. Length, about 4½ inches.

The real food of the Carolina chickadee consists of moths and caterpillars. Moths were found in only 1 stomach, their pupæ in 16, their eggs in 20, and their larvæ (caterpillars) in 138, or about two-thirds of those examined. The month of greatest consumption is October, when they amount to more than three-fourths of the food (78.1 per cent). The month of least consumption is December, when they still aggregate more than a tenth of the yearly food (11.74 per cent). The average for the year (44.42 per cent) is exceeded by cuckoos, but by few if any other birds. Chickadees have a habit of beating their prey to pieces on a branch of a tree before swallowing it, so that the stomachs contain only fragments not easy to identify. It is probable that in these were many notorious pests, for the pupæ of codling moths were recognized in five stomachs and the eggs that produce one of the tent caterpillars in two.

Like many other tree-inhabiting species, the Carolina chickadee eats very few grasshoppers, but some were taken irregularly through the year (1.04 per cent). In five months, including August, the grasshopper month, none were eaten at all, and but few at other times. So far as stomach records show no genuine grasshoppers were eaten, but only some of their allies in their lowest or first stage, viz, the egg. In 11 stomachs were found the eggs of katydids; in 5 the egg cases of cockroaches; in 1 a grasshopper's egg; and in another a cricket's jaw.

Flies are practically ignored. What were probably the eggs of a crane fly were found in one stomach, but no adult flies were noted.

Spiders seem very palatable to the chickadee, being eaten every month and showing a higher percentage (10.9 per cent) in the stomachs than any other animal food except caterpillars. In five stomachs collected in March they amount to 44.6 per cent, but a greater number of stomachs would probably modify this record. One stomach was practically filled with the remains of sowbugs. These appear to be the only animal food eaten that can not be obtained from a tree, shrub, or weed, and it is not clear how the chickadee could get them, for sowbugs are essentially terrestrial in habit and are usually found under a stone, clod, or mass of practically decayed vegetation. A few bones and other tissues of a small unidentified vertebrate taken in June complete the animal food.

The vegetable food of the Carolina chickadee consists chiefly of fruit and seeds. Blackberries or raspberries, found in two stomachs; blueberries, in one; and fruit pulp not further identified, in five, constitute 2.17 per cent of the food for the year. Seeds of poison ivy (10.07 per cent for the year) appear to be a favorite food in the colder months, but only the waxy coating is eaten. This is taken off and swallowed and the real seed rejected, so that the bird does not aid in the distribution of this noxious plant as do so many birds that swallow the seeds and afterwards either disgorge them or pass them through the alimentary canal to fall and germinate in a different locality.

Other seeds, most of them so broken and ground up as to be unidentifiable, were eaten to the extent of 12.38 per cent, chiefly in the colder months. In nine stomachs taken during this season were pieces of liverwort, a plant of the lower order that grows upon the bark of trees or damp rocks. This seems a very curious food for a bird, and is probably taken when other supplies are scarce.

In a résumé of the food of the Carolina chickadee, one is impressed with the fact that a large proportion consists of the eggs, pupæ, and larvæ of noxious insects. As an enemy of caterpillars the bird has few peers. It also destroys a great many of those two pests of horticulture, plant lice and scales.—F. E. L. B.

TUFTED TITMOUSE.[1]

The tufted titmouse inhabits the whole of eastern United States from the Gulf to southern Iowa and northern New Jersey. It is contented with various kinds of surroundings and will nest as readily in a box erected in the dooryard or garden as in the midst of the deep forest. Its preferred nesting site is an old woodpecker-hole or an unoccupied box put up for a wren, and it usually remains in the vicinity of its nest during the year. It is a rather noisy bird and keeps up its monotonous cry with tiresome iteration. In winter small flocks assemble, probably family groups, and ceaselessly wander about the forest in search of food, scrambling about the trunks and larger branches of trees for hidden insects and their eggs. At such times, they are very tame and pay little attention to human intruders. At the approach of spring they separate into pairs.

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[1] *Bæolophus bicolor.*

For investigating the food of the tufted tit 186 stomachs were examined. These were too few and too irregularly distributed through the year to afford more than an approximation of the bird's economic worth. The food consisted of 66.57 per cent animal matter to 33.43 per cent vegetable. Contrasted with the food of the brown thrasher, in which no one article predominates, that of the tufted tit includes one item, caterpillars, which forms more than half the animal food, and two items, caterpillars and wasps, which are more than half the whole food.

Beetles make up 7.06 per cent of the subsistence, and of these only one-tenth of 1 per cent are useful species. More than two-thirds of the beetles (4.94 per cent) are snout beetles, or weevils. Among these the cotton boll weevil was found in four stomachs. The remainder (2.02 per cent) are of various families, all harmful.

Ants are eaten by this tit occasionally, but in the light of present evidence can not be considered a standard article of diet. Other hymenopterous food, i. e., bees, wasps, and sawfly larvæ, is eaten much more extensively (12.5 per cent), and as the sawfly larvæ predominate, the winged forms are not in the majority among the hymenopterans. The tufted tit, like the cuckoo in this respect, takes many sawfly larvæ when searching for caterpillars.

Bugs, principally stinkbugs, tree-hoppers, and scales, or bark lice, are eaten to a moderate extent (4.03 per cent) in seven of the twelve months. Their absence from September to January, inclusive, would probably disappear with a greater collection of stomachs. Scales were the most numerous of the bugs, and in two stomachs specimens of the European fruit scale were identified. In one stomach, and this taken in January, were found the remains of a single fly; from this record it may safely be asserted that flies are not a favorite food of this bird.

Caterpillars apparently stand at the head of the dietary of the tufted tit, aggregating more than half the animal food for the year (38.31 per cent). They were eaten in every month but one—November. Of six stomachs taken in that month not one contained caterpillars, although both October and December stomachs show fair percentages. The one stomach taken in August gives that month the highest of any, 76 per cent. The titmouse is so small a bird that the caterpillars eaten are mostly torn in pieces before being swallowed, thus making identification difficult or impossible, but the cotton leaf worm was identified in one stomach. No grasshoppers or crickets were found. The only traces of orthopterous insects (0.42 per cent) were eggs of katydids, egg cases of cockroaches, and a jaw and an ovipositor thought to be of a grasshopper.

Spiders are picked up in moderation and rather irregularly. They are evidently a makeshift food, and were found in 40 stomachs examined in May (12.67 per cent), 7 stomachs in June (a mere trace), and 3 stomachs in July (16.33 per cent). Thousand-legs were not found. A few snails make up the remainder of the animal food.

Of the vegetable food, corn was discovered in one stomach, evidently taken on trial. Fruit was eaten to a moderate extent (5.15 per cent), mostly in midsummer, and included raspberries, blackberries, and strawberries, which might have been of cultivated varieties, but probably were not. The wild fruits were such as grow by the wayside and in swamps, as elderberries, hackberries, blueberries, huckleberries, and mulberries. Seeds of various kinds, as sumac—including poison ivy—bayberry, or wax myrtle, aggregate 4.07 per cent. It is difficult to draw the line between broken seeds and mast in stomachs of the tufted tit, but, together considered as mast, these form more than two-thirds of the vegetable food. While largely composed of acorns, there is no doubt that chinquapins and beechnuts and many smaller seeds enter into its composition. As thus defined, mast amounts to 23.4 per cent of the whole food, comprising 95 per cent of that eaten in November, 50.42 per cent in January, and 55.97 per cent in February; in fact, it is the principal vegetable food eaten from August to February. That such small birds should crush such hard nuts as acorns and chinquapins is surprising, but the broken fragments found in the stomachs well demonstrate their ability.

From the foregoing discussion of the food of the tufted titmouse, it is evident that the bird is beneficial, and so far as this investigation shows it has no bad habits or tastes to offset the good it does by its destruction of noxious insects. If encouraged, it becomes domestic, and, like the wren, lives about the garden and helps to keep in check the hundreds of insects that prey upon the products of cultivation.—F. E. L. B.

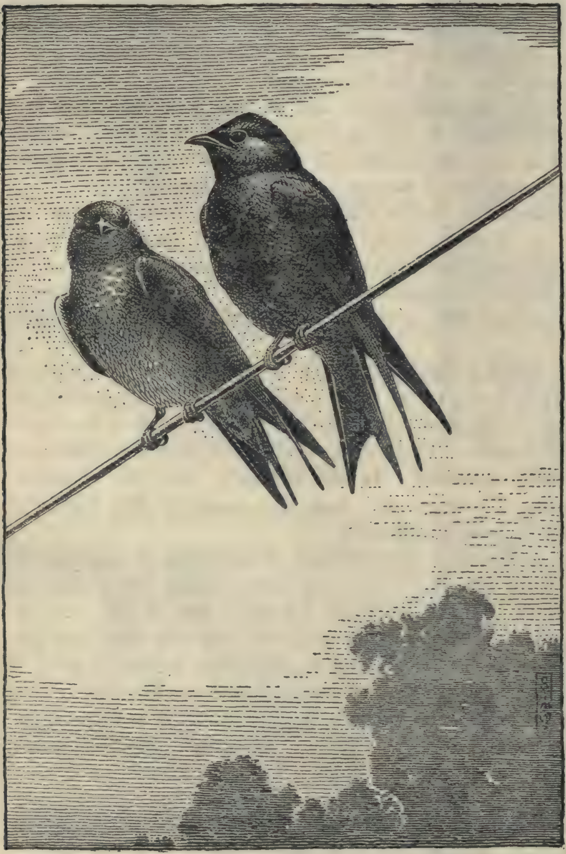
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FIG. 14.—Purple martin. Length, about 8 inches.

PURPLE MARTIN.[1]

The purple martin (fig. 14), or house-martin, as it is more commonly called, occupies the whole of the United States during the breeding season, but is rather more numerous in the South. Its habit of building nests in boxes provided for its express use has caused it to become the most domestic of all swallows. Besides houses erected for them, the birds do not disdain gourds hollowed out and hung on poles. As their food is taken on the wing, clear, open lands, especially low moist meadows, offer them better foraging ground than orchards or groves. While the greater part of their food consists of insects that fly, a few wingless forms, as ants, spiders, and caterpillars, are taken, but these are most likely picked from the tops of weeds as the birds dart past. Some ants have wings at certain times and so become part of the usual fare. In this investigation of the martin's food, 56 stomachs were examined, taken in the five months from March to July, and the contents found to consist entirely of animal matter.

As might be expected, beetles do not occupy a high rank in the food of the martin, most of them being but little on the wing. Together they form only 5.14 per cent of the whole food. Less than 2 per cent are the predacious ground beetles, and less than half of 1 per cent snout beetles or weevils.

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[1] *Progne subis.*

Ants (3.68 per cent) were eaten in May, June, and July. Naturally, these were the winged forms, though a few wingless ones may occasionally have been taken. Other hymenopterans, as bees and wasps, are taken much more frequently (14.67 per cent).

True bugs form the largest item of diet of the martin and consist for the most part of the larger flying species, as stinkbugs, shield bugs, and leaf-legged bugs, with some tree-hoppers. They are found in the food of every month and in all amount to 41.41 per cent. The great bulk of the bug tribe are noxious insects and include some of the worst pests of agriculture.

Flies are eaten to the extent of 7.2 per cent, and consist largely of the long-legged crane flies, or "daddy longlegs," so called. Lepidopterans are represented in the stomachs of most birds by their larvæ, commonly known as caterpillars; but the martin, taking its food on the wing, catches the adult insects, the moths, or butterflies. Most of the moths eaten, however, are very small, so that they form only 1.25 per cent of the food. Butterflies were found in only one stomach. Grasshoppers and crickets (3.58 per cent) are eaten principally in May and June, instead of August, which, with most birds, is the usual month for eating grasshoppers.

A somewhat peculiar article of the martin's diet is the remains of large dragonflies, found in 29 of the 56 stomachs examined. Six stomachs were entirely filled with these rather formidable looking creatures. As dragonflies feed upon mosquitoes and other small insects, the martin can not be considered as doing man a service by eating them. Besides insects a few spiders also were eaten.

Among the harmful insects destroyed by the martin may be mentioned the clover leaf weevil, found in a number of stomachs, one of which contained upward of 40 individuals. An engraver beetle, a form that does great damage to timber, was found in one stomach and the cotton boll weevil in another. Several stomachs contained honey bees, but all were males or drones.—F. E. L. B.

SCISSOR-TAILED FLYCATCHER.[1]

The scissor-tailed flycatcher (fig. 15) is found chiefly from central and eastern Texas and Oklahoma to southern Kansas during the months from April to October, and casually in western Louisiana, western Arkansas, and southwestern Missouri. It occasionally wanders to far-distant sections, and in winter moves farther south and with few exceptions retires beyond the southern boundary. Like the kingbird, it prefers for nesting sites open country, and it seems to be best suited with prairies or rolling land with scattered trees. In settled territory it takes kindly to orchards and even gardens in the near vicinity of buildings. While generally a quiet bird living on good terms with its neighbors, it displays some of the aggressive spirit of the kingbird as regards crows and hawks, and whenever they appear near its nest attacks them with great vigor.

The following discussion of this bird's food is based upon examination of the contents of 128 stomachs rather irregularly distributed over the seven months from April to October. All are from Texas except one from Florida, which is considerably outside of the bird's usual range. The stomach contents were divided between 96.12 per cent animal food, practically all insects and spiders, and 3.88 per cent vegetable, chiefly small fruits and seeds.

Of the animal food, beetles (13.74 per cent) form a rather constant article of diet. Less than 1 per cent belong to theoretically useful families. The others are practically all harmful. The well-known 12-spotted cucumber beetle, which is often very injurious to the cucumber, as well as to squash vines, corn, clover, beets, beans, peas, and asparagus, was found in one stomach. Snout beetles, or weevils, occurred in a number of stomachs, and the well-known cotton boll weevil in four. Most of the beetles are consumed in May, and the least in June, but as only two stomachs were taken in the latter month the record is subject to revision.

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[1] *Muscivora forficata.*

Bees, wasps, and ants are eaten to the extent of 12.81 per cent of the yearly food, which is the lowest record but one for this item among birds of the flycatcher tribe. As a rule this kind of food constitutes one of the most important elements of the flycatchers' diet, as these insects, excepting ants, being almost constantly on the wing during daylight, are peculiarly adapted to these birds' methods of feeding. Those eaten by the scissor-tail are mostly of the larger kinds, i. e., bees and wasps, with very few of the smaller parasitic species.

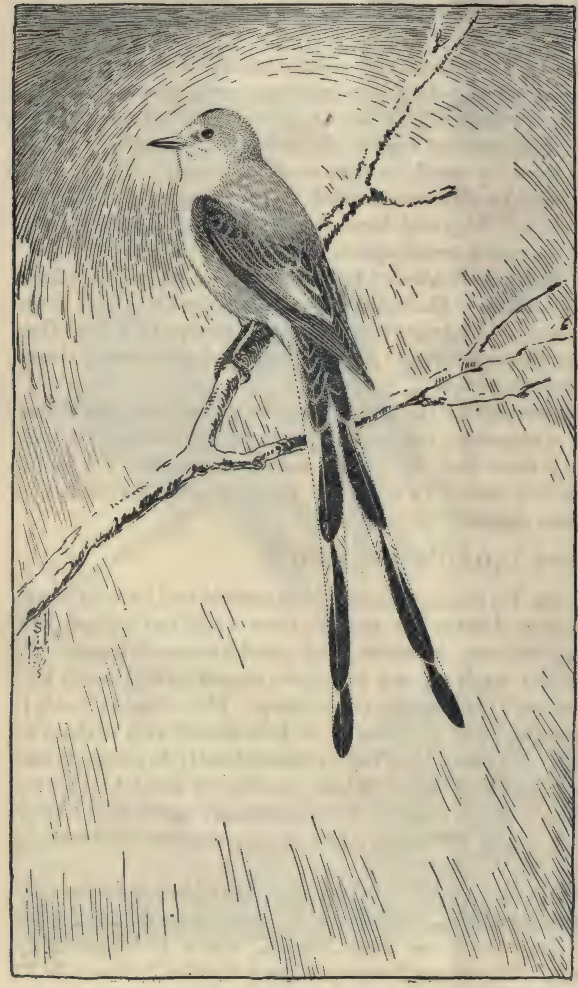
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FIG. 15.—Scissor-tailed flycatcher. Length, about 14 inches.

Bugs (10.17 per cent of the diet) were found in 47 stomachs. At least nine families were identified, but stinkbugs were most abundant and were found in 22 of the 47 stomachs. In two stomachs was identified that disagreeable pest, the squash bug, a creature not classified by entomologists in the stinkbug family, but if disgusting odor were the chief requisite, it is well qualified for that honor. Most of the other bugs identified are harmful. Flies (3.8 per cent), found in the stomachs taken in April, May, and September only, do not seem to appeal to this flycatcher; in 8 of the 14 stomachs they were identified as robber flies.

Grasshoppers and crickets, evidently a favorite diet of the scissor-tail, were found in goodly quantity in the food of every month except April. The average for the year is 46.07 per cent—the highest for any flycatcher. The one stomach taken in October contained these insects to the extent of 86 per cent, but it is probable that the month of maximum consumption is July, when they attain 65 per cent. As this bird is said seldom to alight upon the ground, these insects must be captured during their flights or jumps. In general, grasshoppers and crickets are eaten most by ground-feeding birds, as the meadowlark, while flycatchers take bees, wasps, etc. With this bird the rule seems reversed. Of 128 stomachs, 88 contained grasshoppers or crickets and 8 held no other food.

Caterpillars, with a few moths, constitute a small but rather regular article of diet with the scissor-tail (4.61 per cent for the year), and were found in the stomachs of every month except October. The cotton leaf worm was identified in several stomachs and the cotton bollworm in one. The latter is a well-known pest in cotton fields and also feeds upon a number of other cultivated plants, including sweet corn, from which it is known also as the corn worm. It preys also upon tomatoes and occasionally upon beans and peas. A few dragonflies, together with miscellaneous insects and spiders, complete the animal food (4.92 per cent).

The vegetable food of the scissor-tail consists of small fruit, or berries, and a few seeds. The total percentage, 3.88, indicates that this is not the favorite, but is taken for variety.

The food of the scissor-tailed flycatcher requires but little study to show that where the bird is abundant, it is of much economic value. The bird selects a diet almost entirely of insects, but in this the useful species are so few that they may be disregarded. Its consumption of grasshoppers alone is sufficient to entitle the scissor-tail to complete protection.—F. E. L. B.

RED-COCKADED WOODPECKER.[1]

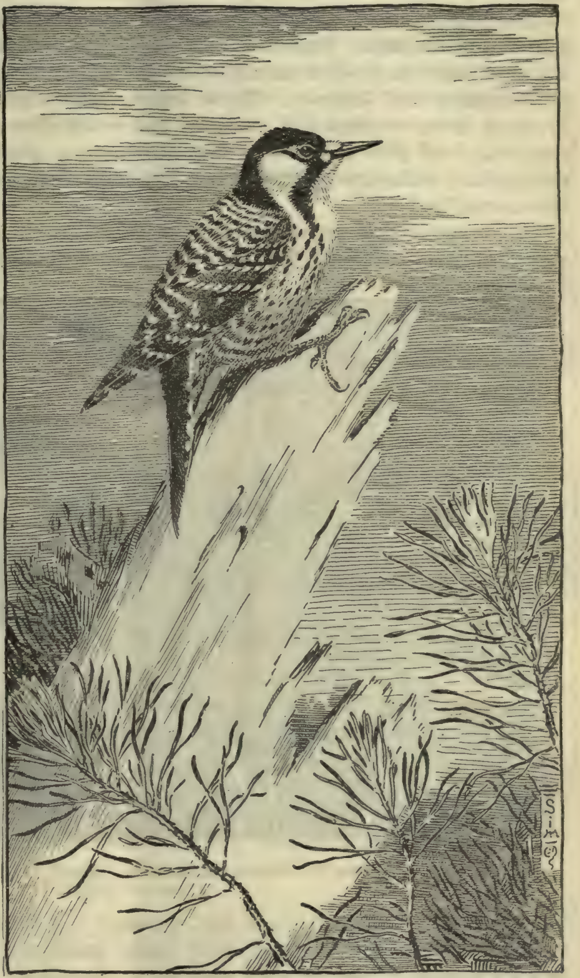

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FIG. 16.—Red-cockaded woodpecker. Length, about 8½ inches.

The red-cockaded woodpecker (fig. 16) is an inhabitant of the Southeastern States from eastern Texas north to southern Virginia and southern Missouri. Pine woods are its favorite haunt, and a large percentage of its food is obtained from pine trees. No complaints have yet been heard that this bird harms crops or forest trees, nor does analysis of its food indicate that such is the case. So far as shown, it does not frequent orchards or cultivated land.

Ninety-nine stomachs from Georgia, Alabama, Florida, Mississippi, Louisiana, and Texas, representing every month, but not many in each, were examined. Of the total food, 86.08 per cent was composed of insects, and the remainder, 13.92 per cent, of vegetable matter, mostly seeds of conifers.

Useful beetles were found in nine stomachs, and amount to about 2 per cent of the whole food. Other beetles, chiefly the larvæ of wood-boring species, aggregate

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[1] *Dryobates borealis.*

15.65 per cent of the annual diet. Of these a number were weevils, or snout beetles. Ants, evidently the favorite food, were eaten to a great extent in every month. December is apparently the month of least consumption (28.93 per cent), and July of maximum (69.6 per cent), but the data are hardly sufficient to give final figures. The average consumption for the year (51.72 per cent) is exceeded by few other birds.

True bugs, many of which are scales, or bark lice, are eaten to the extent of 6.99 per cent of the food. The others are mostly pentatomids, or soldier bugs. Nearly all were taken in the five months from December to April, and two-thirds of them in December and January. These insects, and especially the pentatomids, are lovers of warm weather and sunshine and many live on fruit. It seems probable that this bird gets them from their hibernating places. Grasshoppers, crickets, caterpillars, white ants, spiders, and egg cases of cockroaches, make up the rest of the animal food.

The greater part of the vegetable food, about a tenth of the total, consists of mast, mostly seeds of conifers. This was found in 45 of the 99 stomachs, and appears to be a somewhat regular article of diet, especially in the colder months. Fruit pulp, poison-ivy seeds, bayberry and other seeds, cambium, and rubbish each occurred in a few stomachs, and together amount to about 4 per cent of the food. Corn was found in four stomachs, and unidentified fruit pulp in eight. The cambium was contained in four stomachs, and the seeds of poison ivy in one.

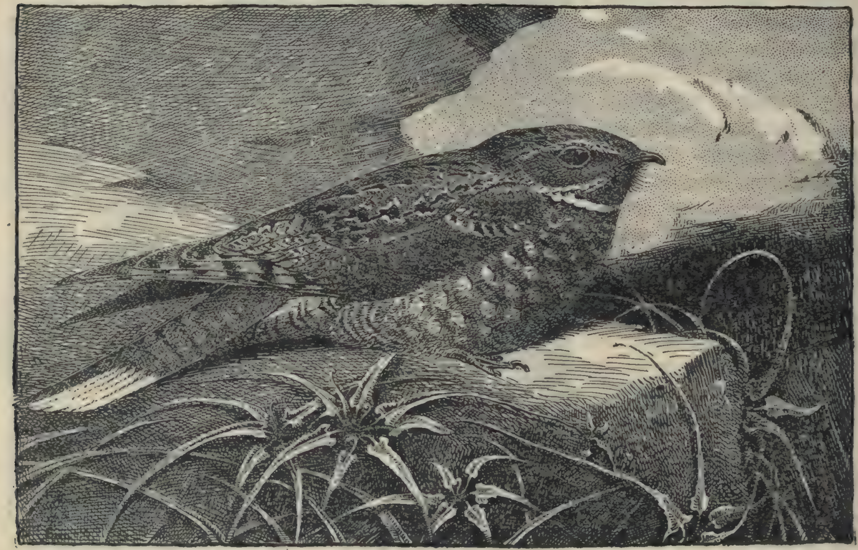

FIG. 17.—Chuck-will's-widow. Length, about 12 inches. B2157-47

From the foregoing it is evident that the red-cockaded woodpecker does little if any damage to products of husbandry and that it does good work in the forest by devouring wood-boring larvæ. No doubt it aids in distributing the seeds of the pines upon which it feeds, but its food has little other economic interest.—F. E. L. B.

CHUCK-WILL'S-WIDOW.[1]

The chuck-will's-widow (fig. 17), an interesting nocturnal bird, breeds throughout the area to which this bulletin is devoted. Like other species of its family, it lays only two eggs, which may be deposited almost anywhere on the forest floor, there being no nest. Intrusion on this spot usually results in the bird moving the eggs, which it carries in its mouth.

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[1] *Antrostomus carolinensis.*

The bird's flight is noiseless and graceful, and is somewhat more extended and sustained than that of the whip-poor-will but less so than that of the nighthawk. Its call note, which has given rise to the name here used as well as to others of similar sound, is like that of the whip-poor-will, with an added syllable.

The color of the chuck-will's-widow is a harmonious blend of buff, brown, and black, well adapted to concealing the bird as it rests quietly in the woods by day. Surrounding the mouth are numerous branched bristles which with the enormous gape make a very efficient insect-catching apparatus. Although the bird is only 12 inches long, the mouth fully extended forms an opening at least 2 by 3½ inches in size. It is but natural, therefore, that the bird should prey upon some of the largest insects.

Not only are large insects captured and swallowed, but even small birds. Three of the 45 stomachs of the chuck-will's-widow thus far examined contained remains of birds, in two cases warblers. As 42 of the 45 stomachs were collected in April and May, the food percentages apply only to those two months. The percentage made up of small birds is 7.21.

Over 58 per cent of the food is composed of large beetles of the family of leaf chafers. Considerably more than half of these are May beetles, the adults of the white grubs so destructive to forage crops and lawns. Among other destructive beetles of this group eaten by the chuck-will's-widow are the spotted vine chafer, and several others injurious to grapevines and apple trees. There were found also in stomachs of this bird specimens of the southern pine sawyer, a borer that in the South has destroyed timber valued at millions of dollars; beetles of a group whose larvæ bore in roots, sometimes of orchard trees; and the palmetto weevil, which is sometimes destructive to palms.

Moths, mostly of large species, compose 12.36 per cent of this bird's food in April and May, and dragonflies 4.63 per cent. Specimens were taken of the largest dragonfly known to occur in eastern United States. Other items of insect food are water beetles, ground beetles, click beetles (the adults of wireworms), crane flies (injurious to pastures), horseflies, roaches, and green locusts.

Despite the fact that the chuck-will's-widow occasionally devours smaller insectivorous birds, it must be reckoned a useful species. It is probable that birds are not deliberately sought, but that they are taken instinctively, as would be a moth or other large insect coming within reach of that capacious mouth. Generally speaking, therefore, the chuck-will's-widow is insectivorous and most of the insects it eats are destructive.—W. L. M.

NIGHTHAWK.[1]

The nighthawk, or bull-bat, has unfortunately attracted more attention as a target for shooting practice than as an object of esthetic and economic consideration. How many thousands of these useful birds have been sacrificed in this thoughtless way it would be difficult to estimate, but the practice has been extant since early times and has resulted in an enormous reduction in their numbers. What is worse, the nighthawk is particularly unfitted to withstand this sort of persecution, as it lays only two eggs. Thus perpetuation of the species under favorable conditions is only barely assured. That the bird deserves very different treatment there is no sort of doubt. As an adornment of the landscape it has few superiors among birds. A flock of nighthawks pursuing their complex but skillful aerial evolutions is an object of interest and admiration seldom excelled. Not only has the species a pronounced esthetic value, but economically it is practically beyond reproach. The nighthawk is strictly insectivorous, and for this reason no blame can be attached to it on the score of its damaging crops. The only charge that can be made against the bird is that it destroys some useful insects, but these are far in the minority.

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[1] *Chordeiles virginianus.*

Nighthawks are so expert in flight that no insects can escape them. They sweep up in their capacious mouths everything from the largest moths and dragonflies to the tiniest ants and gnats, and in this way sometimes gather most remarkable collections of insects. Several stomachs have contained 50 or more different kinds, and the number of individuals may run into the thousands.

Nearly a fourth of the bird's total food is composed of ants. These insects are generally annoying and often very injurious, especially in relation to stored products and in their activities in fostering destructive plant lice. More than a fifth of the nighthawk's food consists of May beetles, dung beetles, and other beetles of the leaf chafer family. These are the adults of white grubs, noted pests, and even as adults many members of the family are decidedly harmful.

Numerous other injurious beetles, as click beetles, wood borers, and weevils, are eaten. True bugs, moths, flies, grasshoppers, and crickets also are important elements of the food, as are several species of mosquitoes, including the transmitters of malaria. Other well-known pests consumed are the Colorado potato beetle, cucumber beetles, rice, clover leaf, and cotton boll weevils, billbugs, bark beetles, squash bugs, and moths of the cotton worm. No fewer than 18 species of bark beetles, which are among the most destructive forest enemies, have been identified in the food of the nighthawk.

Nighthawks deservedly receive full legal protection everywhere, and citizens should see that the law is obeyed. The nighthawk is far too useful and attractive a species to be persecuted. Especial attention should be given to safeguarding any eggs that may be found. They are deposited on the bare ground or rocks, on logs, or on flat gravel roofs in cities.—W. L. M.

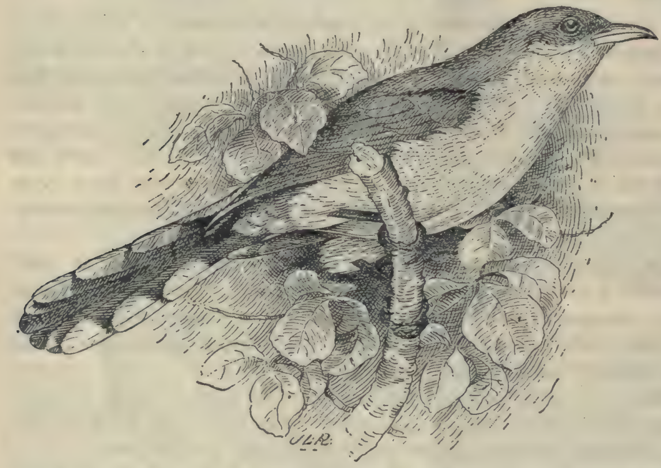

FIG. 18.—Yellow-billed cuckoo. Length, about 12½ inches.

YELLOW-BILLED CUCKOO.[1]

Cuckoos are rather shy birds, keeping among the foliage of trees or bushes and making but little noise. They do not, however, entirely avoid the abodes of man, but where trees are abundant many may frequently be seen about houses or even in the village streets or parks. On very hot mornings in midsummer their familiar though not very musical cry of "kow-kow" is said to presage rain; hence the name "rain crow" by which these birds are frequently known.

The two most abundant species in the United States are the black-billed and yellow-billed cuckoos, but the yellow-bill (fig. 18) is more abundant and better known in the South and probably is the more important economically.

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[1] *Coccyzus americanus.*

The common observation that cuckoos feed largely on caterpillars has been confirmed by stomach examination. Furthermore, they appear to prefer the hairy and spiny species, which are supposed to be protected from the attacks of birds. The extent to which cuckoos eat hairy caterpillars is shown by the inner coatings of the stomachs, which frequently are so pierced by these hairs and spines that they are completely furred.

For this treatise 110 stomachs of the yellow-billed cuckoo were available, all but one taken from April to October. That one, secured in Texas in January, was of a bird which had remained in the United States after its companions had moved on farther south; its food consisted of one large harvest fly or "locust" and two or three spiders, the latter very unusual food at this season.

The contents of the other stomachs were practically all animal matter, only a small fraction of 1 per cent of vegetable rubbish being found in one stomach taken in Texas in August and one seed of sour gum in a stomach taken in Alabama in October. Over 92 per cent of the food consists of three orders of insects, viz, bugs (12.25 per cent), caterpillars (65.63 per cent), and grasshoppers (14.34 per cent).

Bugs found in 37 stomachs were nearly all of the larger kinds, like cicadas, stink-bugs, squash bugs, and leaf-footed bugs. They constitute an important article of food from April to August, after which they disappear. July is the month of greatest consumption (29 per cent), and the average for the four months from April to July is more than a fifth of the whole food (21.98 per cent). Among the bugs were the periodical cicadas and several forms injurious to oranges and melons and other cucurbit crops.

Caterpillars were found in 91 stomachs and in 24 they were the sole contents. One of the most important of these is the cotton worm, found in 34 stomachs in numbers varying from 1 to 150 each. At least four held 100 each, and it is probable that the average number of these insects in the 34 stomachs was 50. It is hardly necessary to comment upon the economic importance of this work. Until the introduction of the cotton boll weevil, the cotton worm was the worst pest with which the southern planter had to contend. In the southern tier of cotton States a loss of a fourth of the crop was formerly expected, and if the yield was not reduced a half the planter considered himself fortunate. Examination of many stomachs shows that this insect is a common article of daily food for the cuckoo, as well as for many other birds, and that these birds must exercise a very important restraint upon its increase.

The apple-tree tent caterpillar was found in one stomach. Where apples are grown this insect is a pest, and it is fortunate that there is a bird ready and willing to restrain its ravages. Another caterpillar eaten by the cuckoo was the red-humped apple caterpillar, an insect that feeds in colonies upon apple and other trees and often does considerable damage. In all, caterpillars constitute two-thirds of the total food of the yellow-billed cuckoo in the South. Few birds feed so exclusively upon any one order of insects.

The natural food for cuckoos would seem to be bugs and caterpillars which feed upon leaves, as these birds live in the shade among the leaves of trees and bushes. Not so with grasshoppers, whose favorite haunts are on the ground in the blazing sunshine, yet these creatures are the second largest item in the cuckoo's diet. Grasshoppers are so agreeable an article of food that many a bird apparently forsakes its usual feeding grounds and takes to the earth for them. Thus it is with the cuckoos; they quit their cool, shady retreats in order to gratify their taste for these insects of the hot sunshine. But there are some members of the grasshopper order that live in the shade, as katydids, tree crickets, and ground crickets, and these are all used to vary the cuckoo's bill of fare. Grasshoppers, crickets, and katydids as a whole constitute 14.34 per cent of the cuckoo's diet.

Beetles (3.16 per cent), eaten so extensively by so many birds, are of minor importance in the diet of the cuckoo. Only a trace of the predacious ground beetles was found. The others were divided into small portions among several families, and no special pest among them was noted. Ants, wasps, and bees comprise less than 1 per cent and are evidently not favorites. A few spiders are taken, mostly in June, and a few moths also are eaten, but the most unexpected food for a cuckoo was three small tree frogs, found in as many stomachs.

As the birds discussed in this paper were collected from a limited area, it will be of interest to take a glimpse at some facts obtained by the examination of stomachs of the same species taken in all parts of the United States. Of a total of about 300 stomachs, the Colorado potato beetle was found in 4; the dog-day harvest fly, or "locust," in 33; the cotton worm in 37, many stomachs containing over 100 individuals; the yellow-necked apple caterpillar in 34, many stomachs completely filled with them; the fall webworm in 3, one of which held 250; and the tent caterpillar in 7 stomachs, frequently to the extent of 100 or more individuals each. In all of these cases the statements are very conservative, as these larvæ are so soft that they soon become unrecognizable in the process of digestion, and only those recently eaten can be identified.

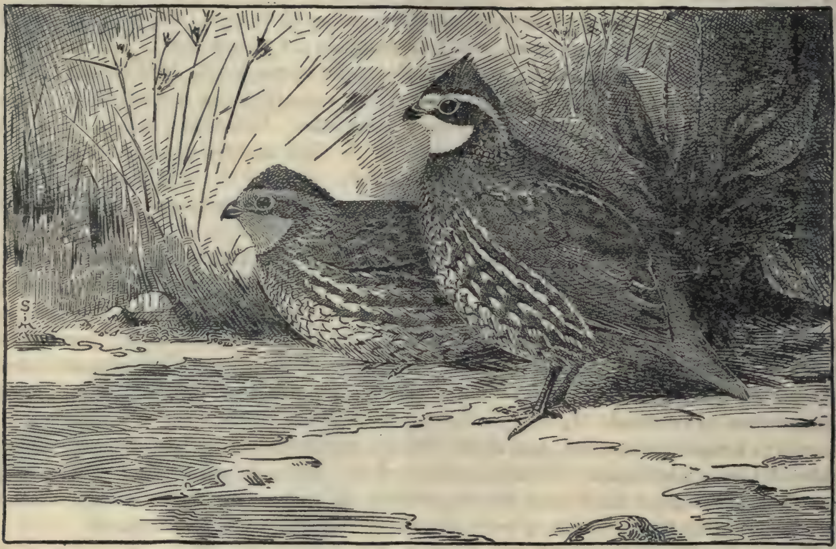

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FIG. 19.—Bob-white. Length, about 10 inches.

The yellow-billed cuckoo is a valuable ally of the farmer. It has no objectionable habits, but does destroy many serious agricultural pests, chief among which are the many species of caterpillars, of which this bird makes about two-thirds of its food.—F. E. L. B.

BOB-WHITE.[1]

No bird is better known to country residents than the bob-white (fig. 19). The bird's cheery calls the year round form part of the most pleasant associations of country life, and its neat form and harmonious coloration, and especially its confiding habits, make it a general favorite.

Any brushy fence row serves as a retreat for its nest, or for winter shelter, and weed-covered fields are its favorite feeding places. Weed seeds form more than half the total food and include those of all the worst weed pests of the farm. Among them may be mentioned crab, cockspur, witch, and foxtail grasses, sheep sorrel, smartweed, bindweed, lamb's-quarters, pigweed, corn cockle, chickweed, charlock, partridge pea, beggar lice, nail grass, rib grass, ragweed, and Spanish needles.

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[1] *Colinus virginianus*.

Acorns, beechnuts, chestnuts, and pine seeds make up about 2.5 per cent of the food, and wild fruits about 10 per cent. The fruits include berries of palmetto, smilax, wax myrtle, mulberry, sassafras, blackberries and raspberries, rose haws, cherry, sumac, grapes, sour gum, blueberries, honeysuckle, partridge berry, and a number of others. The bob-white feeds to a slight extent upon buds and leaves, including those of yellow and red sorrel, cinquefoil, and clover.

Grain forms scarcely more than a sixth of the food, but most of it is taken during winter and early spring when nothing but waste grain is available. The habit of gleaning this after the harvest is beneficial to the farm, for volunteer grain is not desirable, especially where it serves to maintain certain insect and fungus pests. Although most of the grain and seed crops grown upon the farm are represented in bob-white's dietary, no significant damage can be attributed to the bird.

Animal food, chiefly insects, composes nearly a sixth of the bird's subsistence. From June to August, inclusive, when insects are most numerous, their proportion in the food is about 36 per cent. The variety of insect food is great and includes a number of the most destructive agricultural pests. Among them may be mentioned the Colorado potato beetle, 12-spotted cucumber beetle, bean leaf beetle, squash ladybird, wireworms, May beetles, corn billbugs, clover leaf weevil, cotton boll weevil, army worm, bollworm, cutworms, and chinch bug.

On the strength of the bob-white's feeding on the boll weevil, a campaign has been waged in several Southern States for complete protection for the bird. This movement is particularly ill advised, since this bird is by no means prominent among the enemies of the boll weevil. Some 220 stomachs of bob-whites collected in cotton fields have been examined, with the result that a single boll weevil was found in one stomach. The reports of bob-white's eating large numbers of boll weevils are based on field observations, which are very liable to inaccuracy, and upon the behavior of captive birds, which has little if any value as an indication of their habits under natural conditions.

On the other hand, the food habits of the bob-white undoubtedly are beneficial and the bird should be maintained in numbers on every farm. This is not to say that all shooting should be prohibited, for the bird is very prolific. But its numbers should not be reduced below what the available nesting sites and range will support.—W. L. M.

SWALLOW-TAILED KITE.[1]

The swallow-tailed kite is not only one of the most common birds of prey in the South, but also one of the most beneficial. Its head, neck, and lower parts are white, and its back, wings, and tail, a glossy bluish black. The bird is as much at home in the air as a swift or swallow, usually feeding and drinking without alighting. Its ease and grace of movement always command admiration.

This kite preys upon beetles, wasps, cotton worms, grasshoppers, and dragonflies. It takes also frogs, lizards, and small snakes. The swallow-tailed kite seems to be entirely innocent of preying upon birds or mammals, after the fashion of so many of its raptorial relatives, and on the whole is a species worthy of preservation.—W. L. M.

TURKEY BUZZARD.[2]

Turkey buzzards (fig. 20) are familiar features of southern landscapes. On the ground they appear uncouth and awkward, but in the air show a skill, particularly in soaring, approached by few other birds. Their wonderful soaring flight has been a subject of study by a multitude of observers, and the buzzard is not only the model but also the inspiration of the American invented aeroplane. The bird is chiefly black in color, but the naked skin of the head and neck and the base of the bill are bright red.[1]

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[1] *Elanoides forficatus.*

[2] *Cathartes aura septentrionalis.*

Buzzards nest on the ground under brush piles, bushes, or palmettos, or in hollow logs or rock crevices. They roost usually on dead branches, and sometimes, especially in winter, congregate in large numbers.

All vultures specialize in feeding on carrion. While under natural conditions the number of dead animals available for them is somewhat limited, yet, where the human population is considerable and sanitary conditions not over good, there is much work for buzzards, and they fill an important place. For nearly three centuries their work has been appreciated at its full value in the South, and these birds have been scrupulously protected.

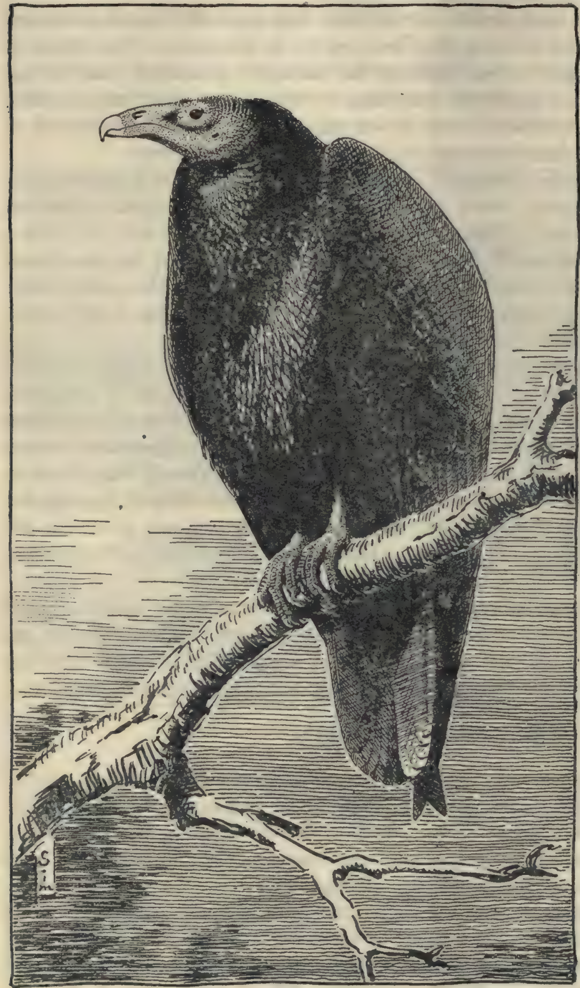
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FIG. 20.—Turkey buzzard. Length, about 30 inches.

The turkey buzzard now is threatened with persecution in the land where heretofore it has received the most zealous protection, for the bird has been accused of spreading such diseases of live stock as hog cholera and anthrax. The charge that it spreads hog cholera has never been demonstrated, and until this is done judgment should be suspended. Its relation to anthrax has been investigated with the result that in the distribution of the disease the bird must be considered a minor agency as compared with man and various domestic and certain wild animals.

The nature of their food would indicate that buzzards have strong digestive powers. The spores of anthrax, or charbon, a virulent stock disease, have been shown by two independent investigations to be destroyed by passing through the alimentary canals of buzzards. Anthrax spores are not destroyed in the digestive tracts of other carrion-feeding animals, as the dog, cat, hog, chicken, or opossum.

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[1] The black vulture (*Catharista urubu*), more abundant near the seacoast and more southern in distribution than the turkey buzzard, differs from the latter in having the head and neck black, and the under surface of the wings silvery. The flight of this vulture is more labored, and accompanied by more flapping of the wings. In general habits the two birds are alike.

It is true that buzzards may carry the germs of anthrax or other stock diseases on their plumage, feet, or bills, and thus distribute them; but all the other animals just mentioned may similarly carry disease germs on the surfaces of their bodies, as may also flies, domestic pigeons and other poultry, horses, mules, and cattle, not to mention members of the human family. In fact at the same time that steps are being taken greatly to reduce or exterminate a wild bird—the buzzard—which may possibly play a minor part in the transmission of anthrax, farmers are harboring several domestic animals that have far greater possibilities as spreaders of the disease. The fact that anthrax may be carried by flies is more than sufficient to explain the most severe epidemics.

Obviously, it is unfair to attempt to place the blame for general dissemination of stock diseases on the buzzard. Considering the multitude of ways in which these diseases may be spread, it can not be doubted that stock diseases would be as widely distributed as now if turkey buzzards were eliminated, as has been proposed. What amounts to proof of this is the fact that hog cholera at times is virulent and seriously destructive in regions where there are few or no turkey buzzards, as in certain Northern States and Canadian Provinces.

Attacks in the South by buzzards upon living farm animals indicate that there are to many buzzards there for the best economic interests. In the North, where buzzards are fewer, such attacks are believed never to occur. Reduction in the number of buzzards may be desirable, especially if accompanied by or resulting from a proper system of carrion disposal, but there is a wide gulf both in meaning and desirability between reduction in numbers and extermination.

Practically the only way to carry on a destructive campaign against the buzzard would be by shooting. Inevitably the guns would largely be in the hands of the less responsible classes of the population, and many birds other than buzzards would undoubtedly be shot. This is a powerful argument against undertaking extermination of buzzards unless it shall be definitely proved to be necessary.—W. L. M.

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WASHINGTON : GOVERNMENT PRINTING OFFICE : 1916

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 756 OCTOBER 11, 1916

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

CULTURE OF RYE IN THE EASTERN HALF OF THE UNITED STATES.

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Agronomist in Charge of Eastern Wheat and Rye Investigations.

CONTENTS.

Introduction 1
Rye varieties 3
Production of the rye crop 5
  Soils adapted to rye 5
  The place of rye in the rotation 6
  Preparation of the seed bed 9
  Fertilizers for rye 9
  Preparation of the seed 11
  Time of seeding 11

Production of the rye crop—Continued.

  Method of seeding 12
  Rate of seeding 12
Harvesting the crop 13
  Date of ripening 13
  Cutting 13
  Shocking and stacking 14
  Thrashing 14
Pests 14

INTRODUCTION.

The United States produces less than 3 per cent of the total rye crop of the world. The bulk of our production is in the eastern half of the country (fig. 1), in 1915 nearly 80 per cent being grown east of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas. In the eastern part of the United States the principal production is in Minnesota and the States east of the Mississippi and north of the Ohio and Potomac Rivers (fig. 2). In the last few years, however, there has been a tendency to increase the acreage outside of the region of

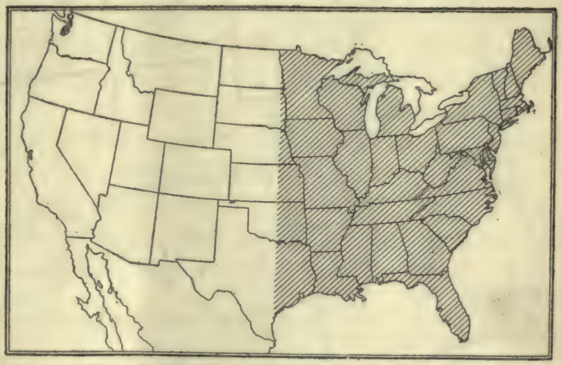

FIG. 1.—Map of the United States, showing by shaded lines that portion of the country to which this bulletin is applicable.

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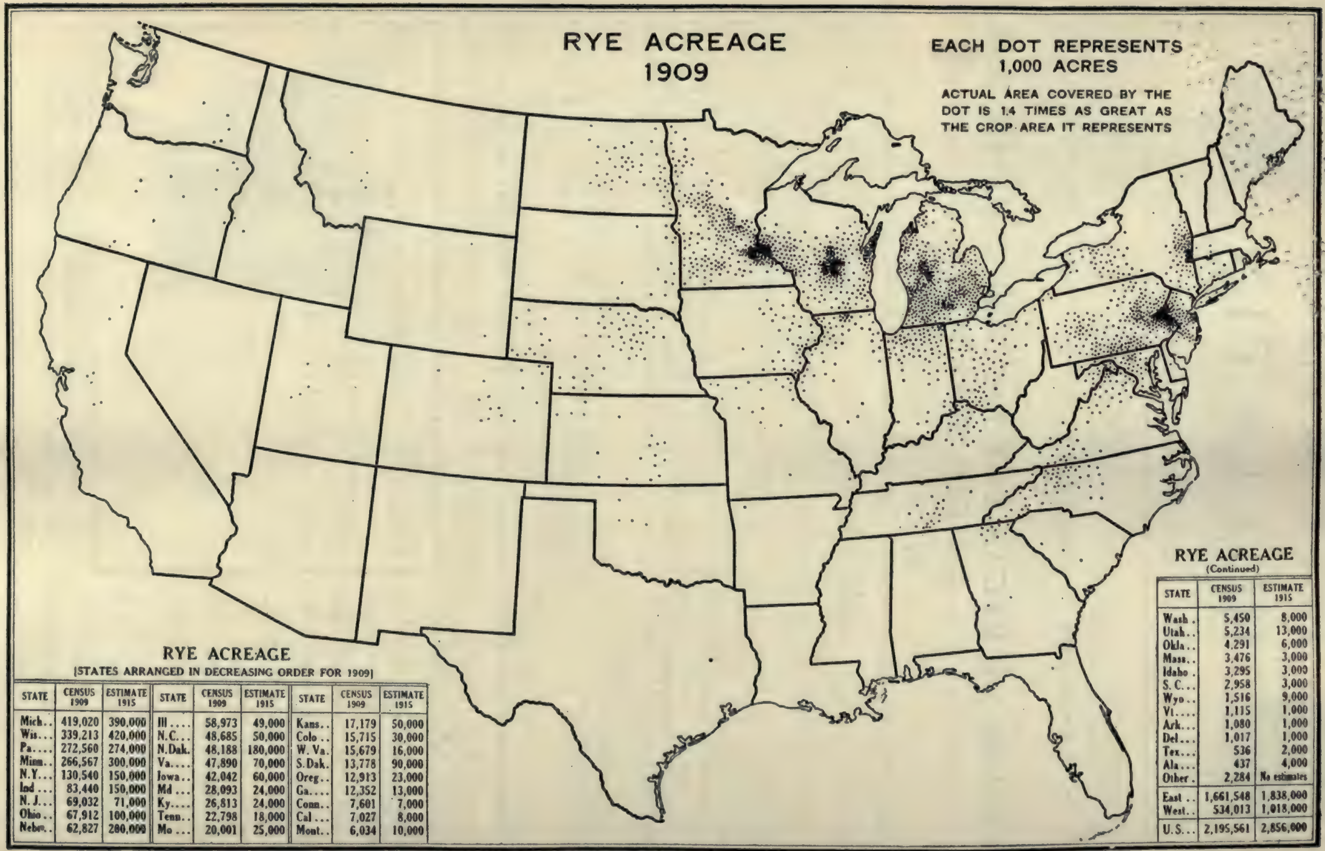
RYE ACREAGE
1909
EACH DOT REPRESENTS 1,000 ACRES
ACTUAL AREA COVERED BY THE DOT IS 1.4 TIMES AS GREAT AS THE CROP AREA IT REPRESENTS

RYE ACREAGE

[STATES ARRANGED IN DECREASING ORDER FOR 1909]

STATE	CENSUS 1909	ESTIMATE 1915	STATE	CENSUS 1909	ESTIMATE 1915	STATE	CENSUS 1909	ESTIMATE 1915
Mich..	419,020	390,000	Ill....	58,973	49,000	Kans..	17,179	50,000
Wis...	339,213	420,000	N.C...	48,685	50,000	Colo..	15,715	30,000
Pa....	272,560	274,000	N.Dak.	48,188	180,000	W. Va.	15,679	16,000
Minn..	266,567	300,000	Va....	47,890	70,000	S.Dak.	13,778	90,000
N.Y...	130,540	150,000	Iowa..	42,042	60,000	Oreg..	12,913	23,000
Ind...	83,440	150,000	Md...	28,093	24,000	Ga....	12,352	13,000
N. J...	69,032	71,000	Ky....	26,813	24,000	Conn..	7,601	7,000
Ohio..	67,912	100,000	Tenn..	22,798	18,000	Cal...	7,027	8,000
Nebr..	62,827	280,000	Mo...	20,001	25,000	Mont..	6,034	10,000

RYE ACREAGE
(Continued)

STATE	CENSUS 1909	ESTIMATE 1915
Wash.	5,450	8,000
Utah..	5,234	13,000
Okla..	4,291	6,000
Mass..	3,476	3,000
Idaho.	3,295	3,000
S. C...	2,958	3,000
Wyo..	1,516	9,000
Vt.....	1,115	1,000
Ark....	1,080	1,000
Del....	1,017	1,000
Tex....	536	2,000
Ala....	437	4,000
Other.	2,284	No estimates
East..	1,661,548	1,838,000
West..	534,013	1,018,000
U.S...	2,195,561	2,856,000

FIG. 2.—Outline map of the United States, showing the rye acreage in 1909. Each dot represents 1,000 acres.

previous largest production. This has been especially marked in Nebraska, North Dakota, South Dakota, and Kansas, while largely increased acreages have been sown in Indiana and Ohio. In Nebraska, for instance, the area sown is estimated to have increased from 62,827 acres in 1909 to about 200,000 acres in 1915, while in Indiana the estimated increase in the same period is from 83,440 to 150,000 acres.

The largest crop of rye ever produced in the United States in one year was in 1915, when the yield was estimated to be 49,190,000 bushels. The lowest yield in the last 50 years was in 1872, when 14,889,000 bushels were produced, while the average for that period was 26,717,560 bushels. During the last four years the increase in production has been marked.

RYE VARIETIES.

Rye is known to many seedsmen and farmers only as winter rye or spring rye. There are, however, a number of varieties of this crop, most of them of comparatively recent introduction.

SPRING RYE.

Spring rye is sometimes grown in the northernmost States. It generally does not yield as well as other spring grains and should not be sown where winter rye will survive.

WINTER RYE.

VARIETIES FOR THE COTTON BELT.

For a great part of the cotton belt the Abruzzes (Abruzzi) variety, introduced from Italy by the United States Department of Agriculture in 1900 and 1904, has given remarkably good results. On account of its rapid and vigorous growth, even in cold weather, it is very valuable for grazing and cover-crop purposes. It also produces goods yields of grain—from 15 to 30 bushels per acre under ordinary farming conditions in the cotton belt. A section of a field of this rye growing on sandy loam soil in South Carolina is shown in figure 3. In the extreme southern portion of the cotton belt there is an excellent variety known locally as South Georgia rye, and perhaps by other names. When sown in this section, it is several days earlier and somewhat taller than the Abruzzes variety.

VARIETIES FOR THE NORTHERN STATES.

The Minnesota No. 2 rye was originated by the Minnesota Agricultural Experiment Station by the selection of several good plants from the Swedish rye. It was introduced in 1908 and gave excellent results, averaging 27.2 bushels per acre the first year it was distributed, as compared with 17.7 bushels per acre produced by other rye sown under similar conditions. This rye also exceeded in yield all other varieties sown at the station for 7-year and 10-year periods. Other good varieties included in these tests are Dean, Petkus, Schlanstedt, and St. John's.

In South Dakota Dean and Swedish rye have given good results.

The Petkus (Wis. No. 1), Schlanstedt (Wis. No. 2), Ivanof (Wis. No. 3), and Dean (Wis. No. 4) varieties give good results in Wisconsin.

The Michigan Agricultural Experiment Station has recently introduced a variety of rye known as Rosen, originated at the station by selection from an imported Russian variety. It is reported to give very good yields of grain in that State.

FIG. 3.—A field of Abruzzes rye growing on sandy-loam soil in South Carolina. This variety averaged 26 bushels of grain per acre for two years on large fields.

The varieties just named will doubtless succeed where conditions are similar to those in the States mentioned.

Other varieties of rye grown in the United States are the Mammoth White and Thousandfold in the Northeastern States and the North Carolina Winter and Virginia Winter in the northern part of the cotton belt.

VARIETIES TESTED AT ARLINGTON FARM, VA.

The following varieties of rye, heads of some of which are shown in figure 4, have averaged at Arlington Farm, Va., in excess of 30 bushels per acre for the three or four years grown: Giant Winter, Abruzzes, Arlington Winter, Virginia Winter, Mexican, Rimpau, Ivanof, and Henry. A plat of one of these varieties is shown in figure 5.

PRODUCTION OF THE RYE CROP.

SOILS ADAPTED TO RYE.

Rye can be grown on almost any of the well-drained soils of the eastern half of the United States. It is better adapted to the lighter loams and sandy soils than to the heavier clay soils. It yields best and produces the best quality of grain on well-drained loam soils in which there is a good supply of lime. It is not limited to such conditions, however, for it does about as well on acid as on nonacid soils and is probably the best grain for sandy soils, also for rough and exposed land. It is much better adapted to sandy and poor soils than wheat, and will endure a greater amount of acidity in the soil than wheat, oats, or barley. It is especially good for heath land, drained marshland, and for cut-over land being brought under cultivation. Rye should generally be the first crop on such lands. It may often be grown in the sandy soils of the coastal plains where other cereals would not succeed. The growing of rye should not be attempted on lands subject to overflow or on which water stands after rains. On lands rich in nitrogen it is likely to lodge.

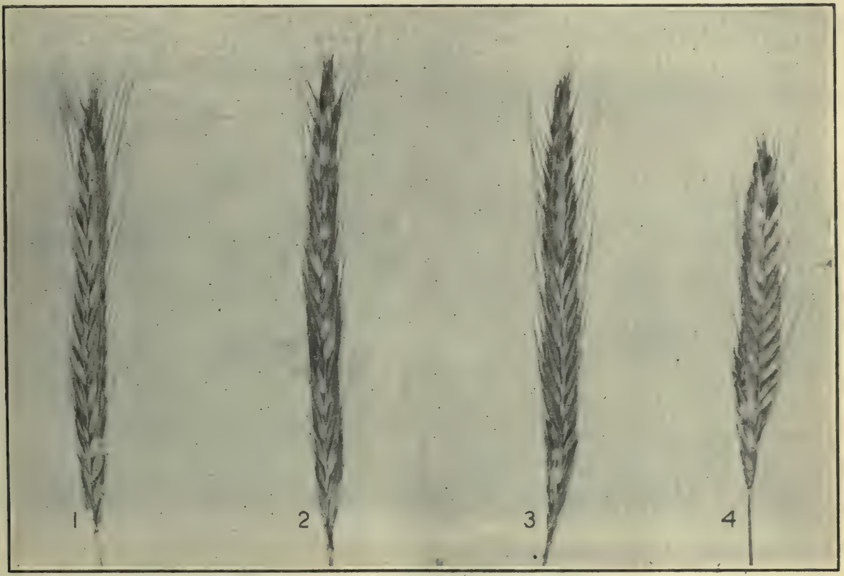

FIG. 4.—Heads of four varieties of winter rye grown at Arlington Farm; 1, Giant Winter; 2, Virginia Winter; 3, Abruzzes; 4, Henry.

Rye does not grow as well as wheat in a wet soil. In drier soils it is more winter resistant than wheat. On poor lands rye generally does better than wheat, but on rich lands this condition is reversed.

THE PLACE OF RYE IN THE ROTATION.

Rye, like other common farm crops, does best when grown in a rotation. It can, however, be grown year after year on the same land more successfully than other small-grain crops, probably because few diseases that affect this plant accumulate in the soil. When rye is grown for grain it may take the place of wheat, barley, or oats in the rotation. Slightly more potassium and about one-fifth less nitrogen are removed from the soil by rye than by wheat when crops of equal weight are produced. As a whole, however, the quality and quantity of the plant foods removed from the soil by rye do not differ greatly from those removed by the other small grains.

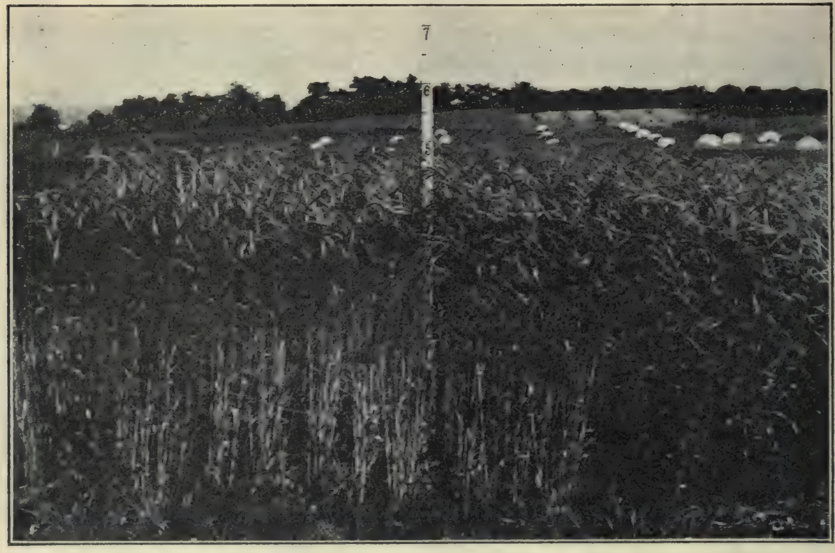

FIG. 5.—A plat of rye at Arlington, Va., ready for harvest. The plants are about 5 feet high.

It is good farm practice to sow rye where possible, following a cultivated crop. An excellent seed bed can then be made as soon as the cultivated crop is off the ground by using a disk harrow, followed by a spike-tooth harrow. The grain is thus seeded with a minimum of labor. If sown early grass and clover seed can be put in at the same time. If desired the rye can be cut while the grain is in the milk stage, early in June in New England and the northernmost States and earlier farther south, and used for straw. A good crop of hay from the grass and clover can usually be secured later.

One advantage of the rye crop is that it can be used to fill gaps between other crops. It can be sown early or late in the fall, on land either rough or well prepared, and it will practically always make a good growth, conserving fertility and preventing washing during the winter. The farmer can then decide in the spring whether to use it as pasture, as a soiling crop, as a green-manure crop to plow under, or as a straw and grain crop.

A cropping system applicable to the corn belt in which rye is used has been described in Farmers' Bulletin 614. In its four-year form the rotation is corn, corn, rye, and timothy and clover, or clover alone, as desired, which is extended into a five-year rotation by allowing the clover and timothy to stand two years instead of one. In this rotation the corn may be hogged off the first year; the second year the corn is cut and rye sown, or the rye is sown in standing corn. Timothy may be sown with the rye and clover sown in the early spring. This rye and grass mixture can be pastured when the weather allows until the rye straw becomes too tough, when the live stock are taken off and the grain allowed to ripen. About two weeks after the rye is ripe hogs can be turned in and allowed to harvest the crop, which they do thoroughly and profitably. The wait of two weeks is necessary to allow the beards to lose their sharpness and the grain to soften. The grass crop the next one or two years completes the rotation.

A rotation suggested for Minnesota and suitable for other States in the same latitude is—

First year, rye (land fall plowed after crop).
Second year, barley, seeded to clover.
Third year, clover; second crop plowed under.
Fourth year, corn.
Fifth year, barley or other grain.

If the land is infested with weeds, early plowing and subsequent cultivation after the rye and clover crops and thorough cultivation of the corn will aid greatly in destroying them.

In some of the North Atlantic States, where rye straw has a high value, this rotation may be followed successfully:

First year, corn, with a heavy application of stable manure.
Second year, oats, with acid phosphate.
Third year, rye, with acid phosphate.
Fourth year, grass, seeded the year before with the rye.

WHEN TO RAISE RYE INSTEAD OF WHEAT.

Rye is less generally raised in this country than wheat. In most places rye is less profitable as a grain crop, and there is less demand and use for the grain. Why, then, should rye ever be raised by the American farmer, and when, if ever, should rye be grown instead of wheat? The answers to these questions follow:

(1) Rye is hardier than wheat. It can be grown as a winter grain in colder, more exposed places. As an instance, rye is the only winter grain hardy

enough to withstand without protection the conditions in the district between the James River and the Missouri River in South Dakota. If winter wheat is grown, it must have winter protection.

(2) Rye will grow on some lands not adapted to wheat. Sandy, exposed, poor, poorly prepared, or acid land will usually yield better crops of rye than of wheat. On large areas of sandy land in all parts of the country rye can usually be grown to better advantage than wheat. As rye uses less nitrogen, it can be grown on poorer lands. Rye should be sown on newly cleared timberland and drained marshland, as it is more resistant than wheat to the acid condition of the soil which is likely to exist. In this respect it is similar to buckwheat.

(3) Rye may be sown later in the fall than wheat. If the land can not be prepared in time for wheat, owing to rush of work, seasonal conditions, or because some late-maturing crop is occupying the land, rye may well be sown. Rye will germinate more quickly than wheat and at a lower temperature. It will germinate and grow with the temperature but a few degrees above freezing, when wheat would be practically at a standstill. It can be sown after buckwheat or late potatoes are removed, thus furnishing a winter cover and allowing a grain crop to be grown. Since it can be sown late, it distributes labor on farms where wheat also is grown, as the wheat can all be sown before rye sowing is begun.

(4) Rye is attacked by fewer insects and diseases than wheat. The Hessian fly seldom injures it badly. The rye crop usually matures before rust becomes severe.

(5) Rye produces a more profitable crop in some sections of the country than wheat. The five-year (1910–1914) average estimated value per acre for rye is greater than for wheat in the States of South Carolina, Alabama, Texas, Minnesota, North Dakota, and South Dakota.

(6) Rye produces a straw more highly valued for bedding horses, stuffing horse collars, and for use as packing material and in paper making than wheat. Where there is a demand for the straw for such purposes, as, for instance, near the large cities in the North Atlantic States, and special precaution is taken to preserve it, the straw may be more valuable than the grain. More straw per acre is produced on poor land by rye than by wheat.

(7) Rye will endure more acid in the soil than wheat and can therefore be used where wheat would require liming. In such cases rye can be produced more cheaply. For instance, on the Volusia soils of northern Pennsylvania and southern New York, which are uniformly acid in reaction, being markedly in need of lime, rye is the leading winter grain crop.

(8) Rye uses less nitrogen, pound for pound of crop produced, than wheat, the amount in rye being about four-fifths that in wheat. It can therefore be grown on poorer lands, can be produced with less fertilizer, and does not exhaust the supply of nitrogen so much as wheat.

(9) Rye is generally a better crop for fall, winter, and spring pasture than wheat, as it makes a larger, earlier, and more upright growth than wheat.

(10) For the reasons above cited, rye is generally better for a winter cover and green manure than wheat. In the South it can be sown in cotton at the time of the first or second picking or in standing corn and it makes a good growth for plowing under in January in preparation for cotton or corn. In the North it can be sown in standing corn or after some other crop and can be plowed under in May in preparation for corn or some other crop.

VOLUNTEER RYE.

Rye will often reseed itself for several years in fields where conditions are favorable after it is sown. This volunteer rye is objectionable if wheat follows, as the grains of rye and wheat can not be separated by cleaning machinery. If rye is present in wheat used for flour making in amounts as high as 2 per cent or more, it lowers the quality of the bread.[1] For this reason millers and grain dealers frequently make a considerable discount in the price of wheat containing rye. Special efforts should be made, therefore, to prevent the mixing of rye with wheat. Sowing mixed seed should be avoided, and volunteer rye should not be allowed to grow in wheat fields.

PREPARATION OF THE SEED BED.

While rye generally does better than any other cereal on a poorly prepared seed bed, this is not sufficient reason for neglecting the proper preparation of the soil. The extra expense incurred in preparing a good seed bed will be more than repaid by the additional yield obtained. If rye is to follow a drilled crop, the land should be plowed 5 to 7 inches deep at least four weeks before seeding, and earlier if practicable. Immediately after plowing, the land should be gone over with a harrow or other implement suitable for breaking clods and reducing the topsoil to a fine, mellow condition. After this it should be so handled as to prevent the growth of weeds and to provide a seed bed firm and compact beneath, but loose and mellow in the upper 2 or 3 inches. The exact method for securing these results must be varied to suit individual conditions.

When rye is to follow a cultivated crop that has been removed, the land may be plowed 3 or 4 inches deep and harrowed if there are many weeds present, or it may be disked and harrowed, as conditions seem to demand. The aim should always be to obtain a seed bed such as that described above. Cowpea or corn stubble can usually be prepared for rye by disking and harrowing. Rye may be sown broadcast in cotton, corn, or other standing crops without previous soil preparation, but it should be covered after sowing. A broad sweep, double shovel, or cultivator is a suitable implement for covering, passing once between every two rows. Cotton or corn is not injured by this treatment. A 1-horse, 5-hole drill can also be used to advantage, as this will pass between the rows of the standing crops.

FERTILIZERS FOR RYE.

Although rye will grow on very poor soils, large yields of forage or grain may be expected only on soil that is of good fertility. Rye for grain production should not be sown on very rich land; neither should large quantities of fertilizers containing nitrogen be applied to the crop. Stable manure is the best fertilizer for general use with rye, but phosphorus should generally be applied in connection with it. The addition of 40 to 50 pounds of acid phosphate or rock phosphate to each ton of manure and the application of 2 to 4 tons per acre of this combination should be generally profitable on poor land. Larger applications may be made on very poor land. When commercial fertilizers only are available, an application of acid phosphate at the minimum rate of 200 to 300 pounds per acre when the crop is sown is generally advisable. Cottonseed meal may also be used to supply nitrogen, this being applied two or three weeks before seeding, or at the time of seeding, but not in contact with the seed. Nitrate of soda may often be used to good advantage. This should be applied with discretion, however, as an excess of nitrogenous matter will result in serious loss from lodging. Rye requires considerably less nitrogen for good results than wheat. On the poorest soils 25 pounds of nitrate of soda may be applied at seeding time and 50 to 75 pounds used as a top-dressing after growth starts in the spring. On richer soils the spring application is generally sufficient. On soils that are naturally rich, or that have been fertilized for preceding crops, fertilizers for the rye crop may not be necessary.

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[1] For further information on the effect of rye flour in wheat flour, see U. S. Department of Agriculture Bulletin No. 328.

Where rye is grown for pasture, for soiling purposes, or for the straw, larger applications of nitrogenous fertilizers may be made. If the land is not especially fertile, six to eight loads of barnyard manure should be applied after plowing and harrowed in thoroughly. Commercial fertilizer rich in phosphorus should be used if manure is not available. An application of 200 to 400 pounds of a 3–8–4 fertilizer (that is, a fertilizer containing 3 per cent of nitrogen, 8 per cent of phosphorus, and 4 per cent of potassium) can be recommended. If the soil is poor and the plants have a bad color and do not start off well in the spring, an application of 75 to 150 pounds of nitrate of soda as spring growth is starting will increase the yields. This nitrate should be applied evenly, either broadcast by hand or with a fertilizer distributor, when the plants are dry, just before or after a rain. Such an application will also lengthen the time during which the crop may be fed to stock. Such heavy applications of manure and fertilizers are not advisable when the crop is grown for grain, as lodging almost surely would result.

A rye crop of 30 bushels of grain and 3,800 pounds of straw removes from the soil, in the grain only, the equivalent of about 180 pounds of nitrate of soda, 14 pounds of phosphoric acid, 15 pounds of muriate of potash, and 2 pounds of limestone, and, in the straw only, the equivalent of about 90 pounds of nitrate of soda, 10 pounds of phosphoric acid, 50 pounds of muriate of potash, and 20 pounds of limestone.

PREPARATION OF THE SEED.

Seed rye should be thoroughly cleaned and all immature kernels removed before it is sown. As rye loses its germinating power much more rapidly and readily than other cereals, all seed should be tested for germination before sowing and the rate of seeding regulated accordingly.

To make a germination test several lots of 100 grains each should be counted out and placed between clean blotters or Canton flannel or in sand, where they must be kept moist and at a temperature of about 70° F. for several days. The number of seeds which show strong sprouts should then be counted. Seed that is weak in vitality should be discarded or sown at a higher rate per acre than that commonly employed.

TIME OF SEEDING.

The time of seeding rye depends upon the use to be made of the crop. When intended for grain production it should be sown from about September 1 in the northernmost part of the country to the latter half of November or later in the southern.

Rye may be sown a week or two weeks later than wheat unless wheat sowing is unusually delayed, as rye germinates more quickly and makes a more rapid early growth, especially if the weather is cool.

If intended as a pasture crop, as a cover and green-manure crop, or as a combination of these, rye should be sown from two weeks to a month earlier than if it is to be used for grain. When not sown for grain, about August 20 is preferable in the northernmost States, although fair results may be secured by sowing as late as September 5. In the latitude of St. Louis late August or early September is preferable.

In the northern part of the Gulf States it should be sown for pasture, cover crop, and green manure between September 15 and October 15, and about two weeks later in the southern part. A satisfactory time to sow in the cotton fields is just after the first or second picking, about the middle of September.

It is desirable to sow rye sufficiently early for the plant to become well established before winter begins. Where a deep root system is formed early there is less loss from the heaving of the soil caused by alternate freezing and thawing, and the plant also starts growth earlier in the spring. Rye can be sown with success on fertile land in a good seed bed later than it can on poor land in a poor seed bed.

Spring rye may be sown as early as spring oats, or as soon as the soil becomes warm and dry enough to be worked. It is usually sown before either barley or wheat.

METHOD OF SEEDING.

Rye is best sown in drills 6 to 8 inches apart, using a regular grain drill and covering the seed one-half inch to 2 inches deep, depending on the texture and moisture content of the soil. Less seed and labor are required, and a more even and uniform stand is thus secured than by any other method. When a drill is not available, rye may be sown broadcast by hand or with a broadcast seeder and covered by harrowing. The person sowing the seed may save labor and can sow more evenly and rapidly by standing or sitting on the rear end of a wagon as it is drawn slowly back and forth across the field. When sown in a standing crop, such as corn or cotton, rye may be sown broadcast and covered with a plow, sweep, or 1-horse cultivator, passing once between rows, or it may be sown with a drill, such as is shown in figure 6, made for sowing between rows of standing crops. Some farmers when sowing in standing corn or cotton rows sow the grain from horseback.

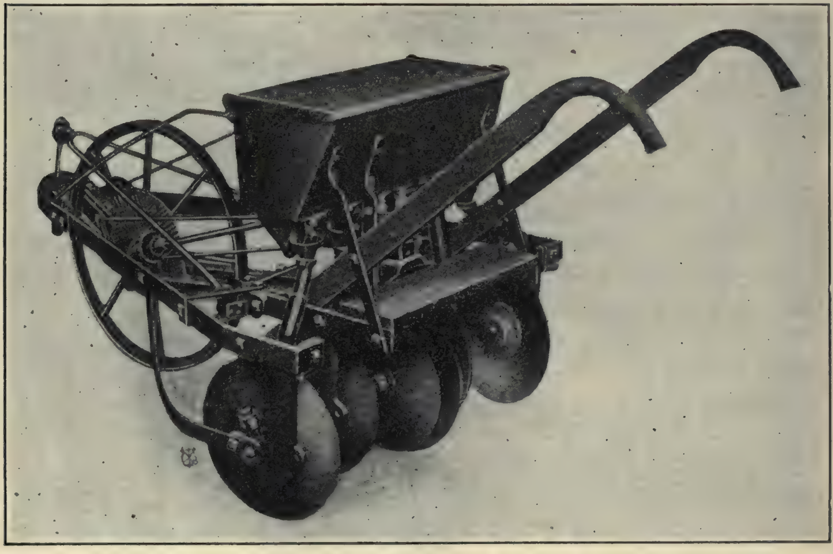

FIG. 6.—A drill made for sowing between rows of standing crops.

RATE OF SEEDING.

While the kernels of rye are smaller and more slender than those of winter wheat, the same quantity of seed is usually sown. In the Eastern States the usual rate of seeding is about 6 pecks to the acre.

Too thick seeding upon fairly fertile soil will produce soft culms, which are likely to lodge or crinkle. On the sandy loam soil in the central cotton belt sowing 2 pecks of Abruzzes rye on good soil and 3 pecks on light soil has given the best yields of grain from November 15 seeding. For later sowings more seed is required.

When intended for soiling purposes more seed should be sown per acre than when the rye is intended for grain. Two bushels per acre is the usual seeding.

HARVESTING THE CROP.

DATE OF RIPENING.

At the northern boundary of Florida rye ripens about the middle of May. In the northernmost States it ripens between July 10 and July 25. For a number of varieties grown for several years in the vicinity of Washington, D. C., the average date of ripening has been from June 16 to 21, although one variety, the Rimpau, has ripened as late as June 27. These figures indicate that as one passes northward from Florida rye ripens approximately one day later for each 15 miles traveled, allowance being necessary, however, for increased elevation.

Rye is generally a few days earlier than wheat in ripening. In comparison with the dates given for the ripening of rye in the vicinity of Washington, 30 out of 43 varieties of wheat have ripened on the average from June 20 to 24, the limits for the 43 varieties being June 17 and June 30, wheat thus averaging some three or four days later than rye, although there is but one day intervening between the earliest wheat and the earliest rye.

Rye cutting may begin a few days before it is fully ripe, or while there is still a slight green tinge about the plant. This is especially desirable when the straw is to be marketed, as a bright, heavier straw results.

CUTTING.

Rye is cut and bound like wheat. The straw of rye commonly grows to a height of 5 feet and frequently reaches 6 feet. On fertile soil it may reach or even exceed 7 feet in height. On account of this long, slender growth it is likely to be more or less lodged and tangled at harvest time, especially on rich soils. It is then extremely difficult to harvest with a self-binder. Even when the grain is standing, it is difficult to cut a heavy crop in this way, as many machines do not have sufficient capacity for such long straw. If there is no special object in saving the straw, the cutter bar may often be raised sufficiently to allow the machine to handle the crop. If the rye is grown principally for the straw, however, a tall crop must often be cut with a self-rake reaper and bound by hand. This requires about four extra men, and is necessarily very expensive. The old-fashioned cradle may also be used in cutting heavy or lodged and tangled rye.

SHOCKING AND STACKING.

Rye is generally shocked in the same manner as wheat and other cereals. Special care should be taken to have the shocks well built and capped, so that as much as possible of both grain and straw will be protected from the weather. As soon as the crop is well cured in the shock, which will ordinarily be in about 10 days after cutting, it should be stacked or put under cover until thrashing time. As the straw is often quite as valuable as the grain, and as its value depends largely on its condition, care in handling between cutting and thrashing is usually well repaid.

THRASHING.

When no special use is to be made of the straw, the method of thrashing rye is the same as that for wheat and other grains. When rye straw is intended for a particular purpose, such as packing material for nursery stock or stuffing for horse collars, an ordinary thrashing machine can not be used, as it breaks and twists the straw too much. The flail was long used for thrashing rye and may still be utilized, but special machines are in use by means of which the grain can be removed without injuring the appearance of the straw.

These machines, sometimes known as "beaters," differ from the ordinary grain separator in that the cylinder is from 5 to 6 feet long and the straw is fed into the cylinder lying parallel to its axis rather than at right angles, as is usually the case. There is no concave, and the cylinder contains no teeth. It is made up of bars with shallow corrugations diagonally across the face, the corrugations on adjacent bars being at different angles. The straw from the unbound bundles is carried over the cylinder, which is run at very high speed, and the grain is beaten out between the cylinder and the top of the machine. The straw is then dropped upon a long inclined shaker, which consists of a number of bars with teeth. These teeth push the straw to the rear of the machine, where it is tied in small bundles by means of a binding attachment similar to those used on binders. A thrasher of this type is shown in figure 7.

PESTS.

WILD ONION, OR GARLIC, IN RYE.

Wild onion, or garlic, is a pest in many of the Eastern and Southern States. The onion bulblets are about the same size and shape as rye grains and reach maturity at the same time. They are therefore harvested with the crop and can be separated from the thrashed grain only with much difficulty. When such rye is sold it is docked severely, often 15 cents or more a bushel. A small percentage of onion bulblets will spoil flour made from the grain, giving the bread a disagreeable odor and flavor. If only a few onions are present in the growing crop, they should be dug out and burned. Land badly infested should, if possible, be used for some other crop than small grains. Rye, however, lends itself to the more or less complete eradication of wild onion, as the crop may be sown late on land plowed and prepared just before planting.[1]

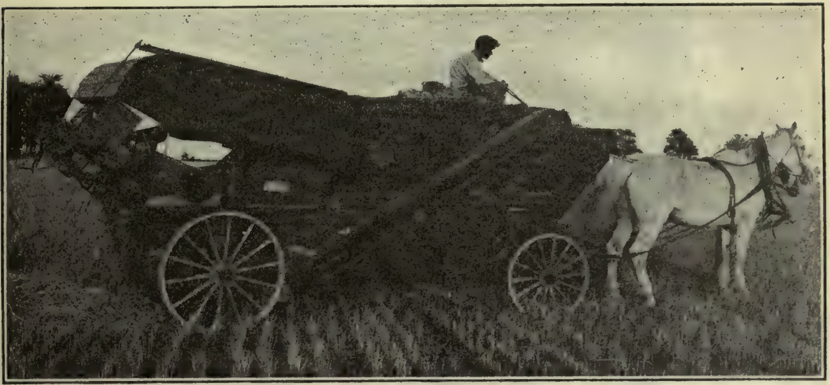

FIG. 7.—A thrashing machine constructed to thrash rye without breaking or twisting the straw. Note the attachment at the rear for binding the straw into bundles. Photographed by H. B. Derr.

INSECT ENEMIES OF RYE.

Rye has no special insect enemies, but is attacked more or less by the same insects, such as chinch bugs, grasshoppers, and army worms, which feed on the other small-grain crops. The Hessian fly does not affect rye as badly as wheat. The granary weevil and the Angoumois grain moth in both the larval (worm) and adult stages live within the stored kernels and may be very destructive.

RYE DISEASES.

Rye is subject to attacks of both stem and leaf rust. These diseases manifest themselves by the appearance of orange-yellow to reddish-brown pustules, which in the one case affect the leaves and in the other the leaves and stems of the attacked plant. The crop is seldom badly injured by these diseases. The flag smut of rye sometimes occurs, usually on the leaf sheath, as reddish-black streaks of spores. Losses of as much as 3 to 5 per cent are sometimes caused by this smut. The occurrence of loose smut of rye has been reported but twice in three years and is of no economic importance.

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[1] For further information on methods of eradicating wild onion, see Farmers' Bulletin 610.

A disease called anthracnose is prevalent in some parts of the rye-growing area. The attacks of this disease are shown by the premature dying of those portions of the heads above the point of its attack, resulting in the almost total loss of the grain in these dead portions. The disease also attacks the roots and lower portions of the stems, resulting in a blackened appearance of the attacked parts and in the loss of vigor of the diseased plant, which therefore produces only shriveled grains. Treatment of the seed with formaldehyde (1 part of formaldehyde to 50 parts of water), as is common for oat and wheat diseases, is a preventive.

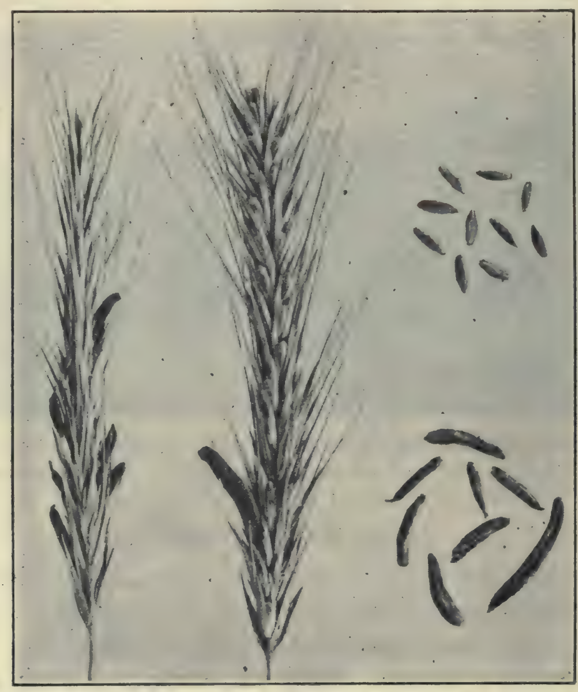

FIG. 8.—Heads of rye showing ergot; also kernels of rye, sound (above) and ergotized (below).

The most serious and destructive disease of rye is ergot (fig. 8). In this, one or more kernels of the head are replaced by a horny violet or purplish structure, usually somewhat larger than the kernel. Where ergot is present rye should not follow rye in the rotation, and seed free from ergot should be sown. It is dangerous to feed rye containing ergot to live stock.

Ergot may be completely separated from rye by passing the grain through a 20 per cent solution of common salt, in which the ergot will float and the rye will sink. This treatment does not affect germination, and the rye can be sown as soon as the excess water has drained off.

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COMMERCIAL VARIETIES OF ALFALFA.

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CONTENTS.

	Page.
Introduction	1
The common alfalfa group	3
Turkestan group	7
Variegated group	8
Grimm	10
Baltic	11
Canadian variegated	12
Sand lucern	13
Other variegated alfalfas	14
Nonhardy group	14
Peruvian	14
Arabian	16
Yellow-flowered group	17
Varieties or strains for various sections	20
Purchasing seed	22
Seed production	23
Possibilities in breeding	23
Summary	23

INTRODUCTION.

It is only within the last 20 years that varieties of alfalfa have been recognized commercially in the United States, and only within the last 10 years have they been given really serious attention. Prior to 1898 no commercial distinction was made between the various lots of alfalfa seed sown in this country, whether they were of foreign or domestic origin. Coincident with the introduction of alfalfa into the various sections of the United States there developed an interest in varieties or strains for special conditions. This interest has resulted in the recognition and adoption of at least nine fairly distinct commercial varieties and strains. These varieties and strains show a great diversity in their adaptations to climatic conditions, some giving the best results in the cold North and Northwest, while others succeed only in the extreme South and Southwest, where the winter temperatures are very mild.

NOTE.—This bulletin is intended for general distribution and will be of interest to farmers in all parts of the United States where alfalfa can be grown.

These alfalfas have been produced for the most part in nature with almost no intentional effort on the part of man. The hybrid varieties are natural crosses, and the distinct types of pure origin are the products of natural selection. However, it is hoped that the results of the systematic plant breeding that has been conducted by the Department of Agriculture and the State agricultural experiment stations during the past decade will soon be available to the general public and that these efforts will produce strains or varieties of alfalfa that will be superior even to the best commercial ones that are now available. The present need is perhaps the greatest for alfalfas that will give profitable yields under the extreme conditions of moisture that exist, broadly speaking, in the West and in the East; that is, for the humid sections and for the semiarid sections, since in these sections the effort to extend the culture of alfalfa is the most active. While improved methods of culture will doubtless be an important factor in the ultimate success which alfalfa may attain in the semiarid and humid regions, nevertheless there is still much to be expected from better adapted varieties or strains.

The commercial alfalfas of this country may be divided into five somewhat distinct groups, each containing strains or varieties that vary considerably within themselves. These groups may be described briefly as follows:

The common group includes the ordinary purple-flowered, smooth alfalfa, of which there are numerous regional strains generally grown throughout the western part of the United States.

The Turkestan group includes alfalfas that have been developed in Turkestan. They differ from the common alfalfas of this country in that they are somewhat shorter and more spreading in habit of growth and are slightly more hairy. No commercial distinction is made between the various strains from Turkestan, all of them being sold under the name "Turkestan."

The variegated group includes the alfalfas that have originated from a cross between common alfalfa[1] and the yellow-flowered species.[2] The Grimm, Baltic, Canadian variegated, and sand lucern are the best known examples of this group.

The nonhardy group includes rather distinct varieties that are very susceptible to low temperatures. They are, in general, very erect in habit of growth, recover quickly after cutting, and have a long growing period. The Peruvian and Arabian varieties are members of this group.

The yellow-flowered group includes the various forms of the yellow-flowered species. They are easily distinguished from members of the other groups by their yellow flowers and crescent or sickle shaped pods.

In this bulletin the word "strain" is applied to alfalfas that are only slightly different from those that are typical of the ordinary purple-flowered alfalfa, and also occasionally to alfalfas that belong to other groups where they are considered with reference to these groups. The alfalfas of the common group that have developed in various regions are called regional strains and not varieties, since they do not possess sufficiently distinct characters to be considered as varieties, while the Grimm alfalfa, for example, which is referred to as a variety when considered in connection with the common alfalfas, may be spoken of properly as a strain of variegated alfalfa.

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[1] *Medicago sativa.*

[2] *Medicago falcata.*

Lack of distinct differences in the seeds of the various varieties and strains, and also in many cases in the appearance of their vegetative growth, has made it difficult for farmers to recognize them readily and has resulted in much careless and unscrupulous dealing on the part of seed producers and seedsmen. There seems to be such a general lack of knowledge with regard to the characteristics of our commercial alfalfas and so much misinformation has been circulated, which has resulted in many cases in disappointment and financial loss, that it is believed that an agronomic treatise on the varieties that have been quite generally advertised and more or less discussed in agricultural literature will be helpful at this time.

THE COMMON ALFALFA GROUP.

Comparatively little is known with regard to the origin of common cultivated alfalfa, although there is good reason to believe that it developed in western Asia and was one of the first plants to be cultivated solely for forage. Since alfalfa naturally is an open-fertilized plant, it is difficult to determine just how many strains are ncluded in what we now call the common variety.

The alfalfa seed that was first sown in this country was introduced from various parts of Europe, but the stock from which most of the common alfalfa of our Western States has been produced was brought to Chile from Spain, and after having been grown there for many years was introduced into California about 1850. For lack of a better term it has been designated as "common alfalfa," or, to be more specific, the term "common alfalfa" has been used to include all of the alfalfas that are not clearly of hybrid origin or that do not have fairly distinct and uniform varietal characteristics, even though within this group what are known as regional strains are coming to be recognized.

In most lots of common alfalfa there occur some plants that grow more quickly than others after being cut. These plants also have a endency to produce somewhat heavier yields and differ from the others in general habit of growth. They are more erect and have comparatively small crowns, which are produced well above the surface of the ground. In contrast to these there are plants that are slightly procumbent in habit of growth and have comparatively broad crowns, which are produced somewhat below the surface of the ground. The plants of the first type are favored by mild climatic conditions, but succumb readily to severe winter conditions. This type of plant is sometimes referred to for convenience as the southern or nonhardy type. Plants of the second type are hardy and predominate as a result of the elimination of the more tender individuals in strains that have been developed in cold climates. This particular type is often referred to as the northern or hardy type. These two types of plants furnish a basis for the development of regional strains, which, as they are at present defined, are produced when common alfalfa is grown for several seed generations in definite localities where eliminating conditions of one kind or another normally prevail.

To illustrate what is meant by "seed generation," the seed produced from the original seeding may be said to be the first seed generation. If this be sown and seed produced from it, such seed would represent the second seed generation, and if this practice be continued for a considerable number of generations under eliminating conditions it will have a tendency to produce a fairly distinct strain of alfalfa.

It is not possible to formulate an entirely satisfactory definition for common alfalfa, since there is no sharp distinction between regional strains and distinct varieties. For example, certain well-recognized commercial varieties are probably nothing more than regional strains developed to a greater degree. The names of the regions in which these varieties have been developed are frequently applied to them as varietal designations, but they are commonly referred to as true varieties and not as regional strains. The Turkestan variety may be cited as an example of what is meant in this connection. A difference is now being recognized between lots of alfalfa that have been grown for several seed generations in the various States, and to such lots names of the States or terms descriptive of the conditions under which they were produced are sometimes applied; as, for example, Kansas-grown alfalfa, Montana-grown alfalfa, irrigated alfalfa, dry-land alfalfa, and many others. Certain regional strains produced in foreign countries are also recognized.

DOMESTIC STRAINS.

The names "Kansas-grown" or "Montana-grown" as used in the general seed trade are not necessarily distinctive. The mere fact that a certain lot of alfalfa seed was produced in Kansas or Montana is of no importance unless such lots of seed were produced as a result of several seed generations grown in these States. The same is true of seed indicated in the trade as "dry-land," "irrigated," and "nonirrigated" alfalfa, and it is safe to say that much undue discrimination has resulted in connection with their sale. Just how many seed generations are required before a variety growing in one locality assumes rather definite characteristics doubtless varies with the nature of the eliminating climatic conditions and can not be estimated definitely. Fortunately, much of the seed that is grown in sections that produce seed with a fair degree of consistency has come from stock that has been grown in these sections for several seed generations. However, it is always well for a prospective purchaser to investigate this point if possible. The history of seed indicated as "dry-land" or "nonirrigated" should be investigated very carefully before purchasing if a price materially above the prevailing price for ordinary seed is asked, inasmuch as the history of such seed is often very uncertain.

FIG. 1.—A field of common alfalfa from Kansas-grown seed.

The so-called regional strains produced in Kansas, Oklahoma, and other States having similar conditions, have a tendency to recover more quickly after cutting and to give better yields than strains produced farther north. This characteristic has apparently been the result of climatic conditions favoring the perpetuation of the more rapid growing and high yielding individuals until a strain is produced that has these characteristics to a rather definite degree. The regional strains from the above sources, therefore, are recommended in sections where the winterkilling of alfalfa normally is not a serious factor. (Fig. 1.)

Ordinary alfalfa grown west of the Rocky Mountains is very similar in its characteristics to that grown in Kansas, Oklahoma, and Texas, and careful tests indicate it to give approximately the same results in sections having comparatively mild winters. Where winterkilling occurs with a considerable degree of consistency, the strains of alfalfa developed in the Northern States are preferable to

those produced farther south. Regional strains from norther
Nebraska, the Dakotas, and Montana are at least somewhat hardie
than those developed in Kansas, Oklahoma, and Texas, or the inter
mountain region, owing, presumably, to the fact that the sever
winters of the North have effected the elimination of a great man
of the tender individual plants. These northern strains of commo
alfalfa are seemingly less productive in mild climates than thos
from the South, but their tendency toward greater hardiness mak
their use advisable for seeding in the North.

It is reasonable to assume that where alfalfa is grown under co
ditions of scant moisture there is some elimination of the less drough
resistant individuals and that if elimination continues throughout
large number of generations a strain superior in drought resistan
must necessarily result, just as comparatively hardy strains have d
veloped, for example, in the Dakotas and Montana. It must be a
mitted, however, that the tests conducted by the United States D
partment of Agriculture and the results of those published by Sta
agricultural experiment stations have not revealed a materiall
superior drought resistance of dry-land-grown alfalfa over the com
mon alfalfa grown either under irrigation or where rainfall is fairl
abundant. The probable explanation is that the lots which we
tested had not come from a sufficiently large number of seed gener
tions grown under conditions of scant moisture. It is very doubtf
whether much of the seed offered upon the market as "dry-land"
"nonirrigated" is in the least superior to that grown under irrig
tion or in the so-called rain belt.

PROVENCE.

Provence is the name that is applied to a strain of alfalfa grow
in southwestern France. According to the definition formulated
the beginning of this treatise, it is classed as a regional strain
common alfalfa and not as a distinct variety. While it was doubtle
introduced into this country at an early date, there is no record of i
introduction under the name of Provence until 1898, when the D
partment of Agriculture procured a small quantity of seed for tes
ing. It was apparently shortly after this date that the name w
used commercially and the seed received limited recognition by t
seed trade.

The Provence strain differs so slightly in general appearance fro
the common regional strain from Kansas that one can scarcely
distinguished from the other. There are, however, a few differenc
of some importance. The Provence commences growth earlier
the spring and continues to grow later in the autumn in the southe
part of the United States than does the strain from Kansas. It al
makes somewhat quicker growth after cutting. However, it is n

quite as hardy and can not be recommended generally north of the central part of the United States.

While the true Provence strain is an excellent one for sections in which severe winters do not occur, it is not commercially important in this country. Very little seed of it is offered on our markets, and a considerable proportion of that offered as Provence is not true to name. On account of the uncertainty of securing reliable seed, purchasers are advised to buy American-grown seed in preference to it.

SPANISH.

Within the past year, and doubtless largely as a result of the war in Europe, there have been imported into this country several thousand pounds of alfalfa seed from Spain. The Department of Agriculture has at various times tested numerous varieties and strains from that country and in general has found them to resemble the Provence alfalfa. It can not advise definitely with regard to the use of the commercial lots that are now being imported until sufficient time has elapsed to give them a thorough trial. It is safe, however, to recommend that the Spanish-grown alfalfa seed be not sown in any of the Northern States, since in all probability the plants resulting from it would not prove to be hardy.

TURKESTAN GROUP.

Ever since 1898, when the Department of Agriculture introduced several lots of alfalfa seed from Turkestan, all of the commercial seed coming from that country has been classed under the name "Turkestan alfalfa" regardless of its characteristics or history. The strains introduced by the department were selected from regions having low rainfall and rather extreme temperatures, where they had been grown for many seed generations. These early importations gave such promising results in the cold, dry portions of this country that a demand at once was created for seed from Turkestan. This demand resulted in the importation of miscellaneous lots of seed from all parts of Turkestan where seed could be obtained profitably. In recent years, however, most of the seed that has been imported has come from Russian Turkestan, where it was produced under irrigation. There is, therefore, considerable similarity between the various commercial lots of Turkestan alfalfa.

The alfalfas that have been received from Turkestan as compared with the commercial strains grown in this country are usually characterized by a lower and somewhat more spreading growth, smaller and slightly more hairy leaves, and finer stems. But it is almost impossible even for a trained botanist to distinguish between individual plants of Turkestan alfalfa and those of the American-grown strains, so that confusion often occurs.

Generally speaking, commercial Turkestan alfalfa has proved to be inferior to the American-grown strains in nearly every case where comparative tests have been conducted. In the eastern half of the United States, where alfalfa seed is not produced in commercial quantities, imported seed was used almost exclusively until within the past few years. Of the several million pounds of alfalfa seed that have been imported annually, approximately 95 per cent came from Turkestan. This fact is responsible for many of the failures that occurred with alfalfa in the Eastern States. In brief, the commercial Turkestan alfalfa yields less than the American-grown strains, is shorter lived, and is less hardy than the Grimm, Baltic, and Canadian variegated. It is therefore not a desirable variety.

Considerable quantities of alfalfa seed are still coming to this country indirectly from Turkestan, regardless of the war in Europe, so that farmers before making purchases should demand the assurance that the seed which is offered them is American grown. Fortunately, commercial Turkestan alfalfa seed can be identified in most cases by the seed of Russian knapweed[1] which it almost invariably contains. The seed of this weed is not found in commercial alfalfa seed from any other source. Being considerably larger than alfalfa seed, of an oblong shape, and of an ivory, whitish color, it can usually be distinguished with little difficulty. (Fig. 2.)

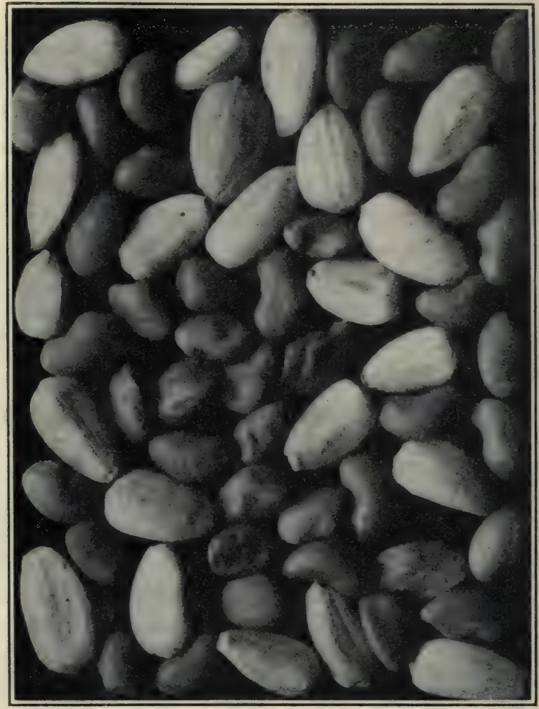

FIG. 2.—Seeds of Russian knapweed mixed with alfalfa seeds. (Magnified five diameters.) This sample shows a much larger proportion of the weed seeds (distinguished by their lighter color and their symmetrical form) than is ordinarily found in Turkestan alfalfa seed.

VARIEGATED GROUP.

Wherever the ordinary purple-flowered alfalfa and the yellow-flowered species are grown side by side a natural hybridization takes place, which results in crosses that show to a greater or less extent the characteristics of both parents. These crosses subsequently intercross among themselves and with the original parent stock, particularly the common alfalfa, thus producing a variety of forms which show considerable range in flower colors. The predominant color of the flowers is the same as of the ordinary alfalfa, but brown, green, greenish yellow, and smoky hues are not uncommon, and occasionally pure yellow flowers occur. It is because of this range in flower color that the name "variegated" has been assigned to the group.

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[1] *Centaurea picris.*

The various members of this group are so similar that it is seldom possible to distinguish between them, but fortunately almost anyone can learn to distinguish a field of variegated alfalfa from one of common alfalfa with a considerable degree of certainty by observing the flower colors and the form of the seed pods. While the greater proportion of the flowers of the variegated alfalfas are the same as those of the common alfalfas, a close examination will reveal some plants having greenish or smoky flowers, and occasionally a pale or yellow one. Furthermore, the seed pods in a field of variegated alfalfa show considerable range in form. Some are circular, semicircular, or loosely coiled, but by far the greater portion of them resemble very closely the compactly coiled pods which alone occur in fields of common alfalfa. In the earlier stages of growth, however, there is no satisfactory way of distinguishing between the variegated and the common groups.

As a rule, the alfalfas that belong to the variegated group are more resistant to cold and drought than the other commonly grown varieties or strains, undoubtedly due in a considerable degree to the presence in their ancestry of the yellow-flowered species. This yellow-flowered species is characterized by its hardiness and drought resistance and occurs naturally over a large portion of Europe and Asia that is too cold and dry for the ordinary purple-flowered alfalfas. It is quite probable that a great many lots of alfalfa that exhibit no marked tendency toward hardiness have some trace of the yellow-flowered alfalfa in their ancestry. Their lack of hardiness may be accounted for partly by the fact that the yellow-flowered species has exerted only a slight influence and partly by the fact that they were probably developed in mild climates. Variegation in the color of the flowers is not positive proof of a variety's hardiness, but it is at least a fair indication. Of the large number of strains of variegated alfalfa in question, the Grimm, Baltic, sand lucern, and Canadian variegated are the only ones that are commercially important. The Cossack and Cherno have been advertised quite extensively, but seed of neither is available in quantity. A few other variegated strains have also been advertised to some extent, but they are at this time of little consequence.

GRIMM.

According to the account published by the Bureau of Plant Industry in Bulletin No. 209, Grimm alfalfa was introduced into Carver County, Minn., in 1857, by Wendelin Grimm, an immigrant from Baden, Germany. It is said that the original lot of seed, which did not exceed 15 or 20 pounds, was sowed in the spring of 1858. Accounts differ as to its hardiness and the success at first attained with it. However, a sufficient number of plants survived the rather severe winters to enable Mr. Grimm to save small quantities of seed from time to time for future sowings. The first considerable quantity was apparently produced in 1867, when 480 pounds were thrashed from 3 acres and sold in Minneapolis for 50 cents a pound. During subsequent years Mr. Grimm's neighbors attempted to grow alfalfa from seed produced in other parts of the United States, but in practically every case the sowings were entirely winterkilled, while at least some of the Grimm plants came through in good condition. The real value of Grimm alfalfa was not generally recognized, however, until the attention of the Minnesota agricultural experiment station was called to it and efforts were made by that station to extend its culture. In 1905 the United States Department of Agriculture began to experiment with this variety, and since that time it has been grown in comparison with a large number of other varieties and strains, and in practically every case has proved itself equal, if not superior, to any of these in hardiness.

To the casual observer, the Grimm alfalfa does not differ materially from the common strains, but a closer examination will reveal a greater diversity of forms, upright and decumbent individuals often occurring side by side. While a large percentage of the flowers are of the same color as those of common alfalfa, there are a few that are greenish, smoky, or blackish, and occasionally a plant is found with yellow flowers, indicating quite definitely that the strain is the result of a cross between the common and yellow-flowered species. The taproots show a tendency to branch and the crowns to be low set and spreading, characters which are undoubtedly of great importance in rendering a variety resistant to cold. In ability to produce seed Grimm alfalfa is about equal to most of the common strains.

The hardiness of Grimm alfalfa is probably due in part to the presence of the yellow-flowered alfalfa in its ancestry and in part to the processes of natural selection which took place under the severe climatic conditions to which it was subjected for a long period of years in Minnesota. On account of its superior hardiness, the variety is particularly recommended for the northern part of the Great Plains region and all parts of the Northwest where little protection is afforded by the snow. It has also proved better able to survive the winters in the colder portions of the humid section of the country, where winterkilling is a serious factor. The greater cost of the Grimm seed and the inability of the variety to produce as large yields of hay in a mild climate as the common alfalfa will have a tendency to confine its culture to the more northern States where hardiness is essential to the success of the crop.

When Grimm alfalfa first began to demand attention, all of the seed was produced in Minnesota, but as conditions there are not favorable for seed production, stock was sent to Montana and other Western States in order that the available supply might be more rapidly increased. Carefully conducted tests of Grimm seed produced in Montana, Idaho, and the Dakotas indicate quite definitely that it has not decreased any in hardiness as a result of having been grown for one seed generation under these changed conditions. The supply of seed on the market is still, however, rather limited and commands a high price. As a result, unscrupulous dealers have offered for sale large quantities of common alfalfa under the name of Grimm. Because of this practice, prospective purchasers should take every means possible to learn whether seed is true to name before buying.

BALTIC.

There is no authentic record of the introduction of Baltic alfalfa into this country, although there is no doubt that the original stock came from Europe. The name Baltic was first applied to it in 1906, for the reason that it had been grown near Baltic, S. Dak., for about 10 years and not, as has been supposed, in the Baltic Sea region of Europe. The original seed sown at Baltic was purchased from a dealer at Hartford, S. Dak., but further than this no information regarding the history of the seed is available.

While the Baltic differs slightly from the Grimm alfalfa in some minor details, the two are so similar that it is seldom possible to distinguish one from the other, and the description as given for the Grimm variety applies equally well to the Baltic. Although there appears to be some evidence that the Baltic alfalfa produces seed somewhat more abundantly than the Grimm, in general the two varieties may be considered equally valuable.

The Baltic alfalfa has unquestionably been developed in much the same way as the Grimm and therefore owes its hardiness to the same causes; that is, the presence of the yellow-flowered alfalfa in its ancestry and the natural elimination of the less hardy plants which has taken place since its introduction into this country.

This variety is recommended for sections where the ordinary strains suffer considerable loss through winterkilling. This includes practically the same territory to which the Grimm is best adapted; that is, the New England States; the greater part of New York, Michigan, Wisconsin, and Minnesota; the northern Great Plains States; and the northern part of Pennsylvania, New Jersey, Ohio, Indiana, Illinois, and Iowa. It is not recommended for sections where the regional strains of common alfalfa will succeed, as the latter have a tendency to produce heavier yields. Comparative tests have shown very little difference in the hay yields of the Baltic and Grimm varieties.

As in the case of Grimm alfalfa the quantity of Baltic seed produced in the United States is rather limited, and the same precautions are necessary in purchasing it. From the evidence that is now available it is safe to conclude that seed of these alfalfas should be approximately the same price, and the farmer would not be justified in purchasing seed of one at any considerable advance in price over the other.

CANADIAN VARIEGATED.

Because of the excellent showing made in the United States by certain lots of alfalfa seed procured from Canadian sources, the United States Department of Agriculture was led to make an investigation of the fields where the seed was produced, most of which are located in lower Ontario. Upon inquiry it was learned that at least part of the original stock came from France, and it is quite probable that some of it was from the sand lucern which is grown in that country as well as in other parts of Europe, since the strain as now produced has its characteristics, including variegated flowers. The fact that it is of hybrid origin, together with the natural selection that has taken place since its introduction into Canada, is responsible for its superior hardiness.

Canadian variegated alfalfa is very similar to the Grimm and Baltic varieties as regards the color of its flowers and its general habit of growth. In fact, these strains are all so much alike that it is seldom possible to distinguish one from the other. It also compares very favorably with the Grimm and Baltic varieties in yield of seed and hay, but, like them, does not yield quite as much as common alfalfa where the latter can be successfully grown. The Canadian variegated has proved more resistant to cold than the common variety and is therefore adapted to the same general region as the Grimm and Baltic alfalfas. In the New England States, and in other States having approximately the same latitude, its superior hardiness as compared with the ordinary alfalfa has been pretty well demonstrated. In tests conducted in the Northwestern States, however, it has not proved quite as hardy as the Grimm and Baltic varieties.

Practically all the Canadian variegated alfalfa seed imported into the United States is grown in the vicinity of Silverdale, Ontario. As the supply is rather limited, it commands a somewhat higher market price than ordinary alfalfa, although generally selling for somewhat less than seed of the Grimm and Baltic varieties.

SAND LUCERN.

It is only during the last 25 years that any attention has been given to sand lucern in the United States, even in an experimental way, although there is little doubt that small quantities of such seed had reached this country many years previous. In 1889 it was grown in experimental plats at the Delaware agricultural experiment station; in 1891 at the North Carolina agricultural experiment station; and near Baton Rouge, La., in 1892. The first noteworthy trial with it was made in Michigan in 1897.

Sand lucern is a hybrid alfalfa and is undoubtedly the parent of our selected strains of variegated alfalfas, such as the Grimm, Baltic, and Canadian variegated. The sand lucern described by the early botanists is quite distinct from the commercial sand lucern. The former probably represents early-generation hybrids, while the latter has been modified by repeated crossings with the common alfalfa.

In general appearance the commercial sand lucern is very similar to the common alfalfa. The presence of the yellow-flowered strain in its ancestry is indicated by the weaker and therefore more decumbent stems, by a certain amount of variegation in the flower colors, and by the presence of some pods with fewer and looser coils. In these respects, as well as in many others, it is quite similar to the Grimm and Baltic varieties.

The commercial sand lucern includes variegated alfalfas that have been grown under all sorts of conditions, and as a result the various lots show no consistent resistance to cold and drought. Some that have been grown for several seed generations under rather severe conditions have become, through natural selection, almost as resistant to cold or to cold and drought as the Grimm variety, while others grown under more favorable conditions are no hardier than the common strains.

The hardier strains of the commercial sand lucern are to be recommended for conditions similar to those under which the Grimm and Baltic varieties have given satisfactory results. The less hardy strains really have no place in this country, because where they succeed the common alfalfa will grow and give larger yields. Owing to the inconsistency in the behavior of the plants grown from various lots of seed, it is doubtful whether sand lucern should be recommended for general use, particularly since we already have other well-known varieties in the Grimm, Baltic, and Canadian variegated which are equal, if not superior, in hardiness, yield, and seed production to the very best strains of the commercial sand lucern.

OTHER VARIEGATED ALFALFAS.

The Cossack and Cherno varieties, which are not as yet commercially important, but which have received quite extensive advertising, belong to the variegated group. A small quantity of seed of each variety was procured by the United States Department of Agriculture from Russia in 1907, and since that time both of them have been tested quite thoroughly by the department.

These varieties are very similar, not only in appearance, but also in value. Since they are comparatively early generation hybrids, their characteristics have not become well fixed. They appear to be hardy and compare very favorably with other hardy alfalfas, but have given no indication of being superior in this respect to the Grimm or Baltic varieties. Only a very limited quantity of seed of either of them is available, and until their superiority over the best commercial hardy varieties and strains has been demonstrated farmers will not be justified in paying the high price that is now asked for the seed.

There are numerous other names that have been used locally in connection with alfalfas belonging to the variegated group, but they have not as yet attracted general attention.

NONHARDY GROUP.

There are certain alfalfas, distinct from the regional strains of common alfalfa which have been developed in the southern part of this country, that are especially characterized by long periods of growth and quick recovery after cutting. These alfalfas are so much more seriously affected by low temperatures than the other commercial varieties or strains that for lack of a better group designation they have been classed as nonhardy alfalfas. Commercially only two strains, the Peruvian and the Arabian, have ever attained any degree of importance in this country. Small quantities of seed of other varieties or strains, including the Guaranda and strains from Mexico (which resemble the Peruvian), and the Elche, Algerian, and Oasis (which resemble the Arabian variety), have been imported at various times but have never been grown extensively in the United States.

PERUVIAN.

So far as available records show, the Peruvian alfalfa was first introduced into the United States from Peru through the efforts of the Department of Agriculture in 1899. The first tests conducted in various parts of the United States indicated conclusively that the alfalfa from this source was quite distinct from that commonly grown in this country. Owing to the fact that under favorable conditions it has produced consistently larger yields than other strains and varieties, the acreage devoted to this variety has been gradually increasing.

In general characteristics the Peruvian alfalfa resembles the common variety, but it is sufficiently distinct to be readily distinguished. On the whole, the individual plants of the former are more upright, less branched, and have fewer and somewhat coarser stems than those of the latter. (Fig. 3.) In thick stands, however, the two varieties differ but little in this respect. The leaves of the Peruvian are somewhat larger than those of common alfalfa, being longer and as wide or wider. The most striking characteristic, however, and the one by which this variety may be distinguished most readily is the pubescence, or hairiness, of the whole plant, giving the foliage a grayish appearance.

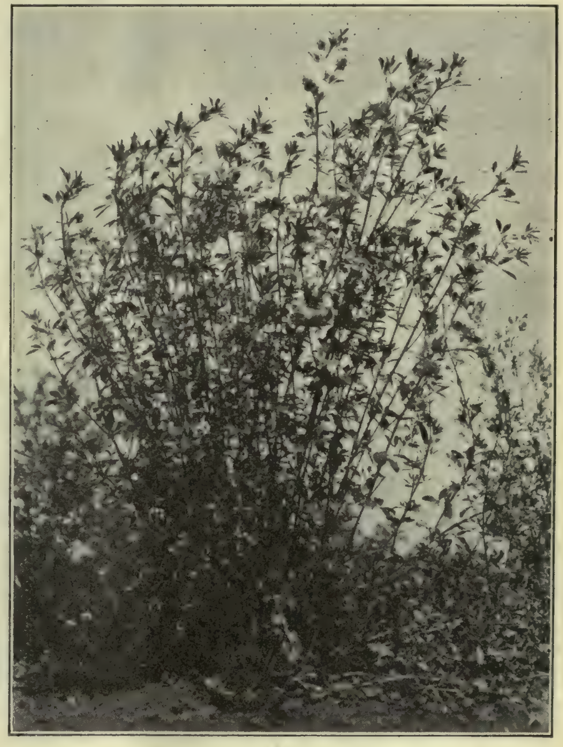

FIG. 3.—A typical plant of Peruvian alfalfa.

Peruvian alfalfa is characterized by its rapid growth, its quick recovery after cutting, and its ability in sections having mild climates to make growth in cool weather after the growth of ordinary alfalfa has ceased. Under such conditions it commences growth earlier in the spring and continues it later in the fall than do most other varieties, thus lengthening its growing period and thereby giving more cuttings per season. Peruvian alfalfa also possesses the advantage of setting seed more abundantly than most other strains, and in parts of the South it seems to be more resistant than other varieties to certain diseases. Its tendency to become coarse and woody when allowed to stand beyond the flowering stage may be considered a disadvantage.

Lack of hardiness will always confine the variety to the southern and southwestern portions of the United States, where the winter temperatures are comparatively mild. It can not be grown to advantage in regions where the temperature falls below 10° F. The variety is not drought resistant and therefore is not to be recommended for dry-farming sections.

At the present time Peruvian alfalfa in the United States is mostly grown in Arizona, California, and New Mexico. While the acreage is not large, the results obtained seem to indicate that this area can profitably be extended, not only to other portions of these States, but also to other Southern States.

As in the case of all alfalfas, the Peruvian variety crosses readily with other varieties when mixed or grown in adjoining fields. Such crossing has a tendency to result in the development of hybrid strains that do not possess the distinct appearance of the true Peruvian variety. This has given rise to the opinion that two strains of the Peruvian variety exist, one the hairy and the other nonhairy or smooth, and has brought about the use of the term "hairy Peruvian alfalfa."

ARABIAN.

The earliest recorded importation of Arabian alfalfa was made through the office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry in 1902, when two lots were received, one from Basra (Bassorah) and the other from Bagdad, Arabia. From time to time small lots of Arabian alfalfa seed have been received in this country, but in recent years the quantity of such seed imported has been almost negligible.

In general appearance the Arabian alfalfa is not markedly different from some of our common strains, but is readily distinguishable. (Fig. 4.) The plants are typically more hairy, a little shorter in growth, and somewhat more bushy than the ordinary alfalfa. However, the hairiness is not quite so pronounced as in the Peruvian alfalfa. The stems and roots are soft, the former being hollow and quite erect. The crowns spread little and set well above the ground. The leaves are generally larger, lighter colored, and broader in proportion to length than almost any other variety. The imported seed is unusually large, thus necessitating the use of a larger quantity per acre for seeding.

The Arabian variety is characterized by its quick recovery after cutting and by its ability to commence growth earlier in the spring and continue later in the fall than any other alfalfa. This makes it possible under favorable conditions to secure one or two additional cuttings in a year, but does not result in a corresponding increase in yield.

The greatest objection to Arabian alfalfa is its tendency to be short lived. Under ordinary field conditions a good stand may be maintained for two years. The third year the plants are less vigorous and the stand decidedly thinned out. The fourth year very few plants are left. Another objection is its poor seeding habits in this country, which render the variety rather difficult to perpetuate.

Arabian alfalfa is not cold resistant and can be grown successfully only in sections having comparatively mild winters, such as occur in our Southern and Southwestern States. It is not injured by high temperatures when there is an abundance of moisture in the soil. Because of its inability to resist drought, this variety is not suitable for dry-farming sections.

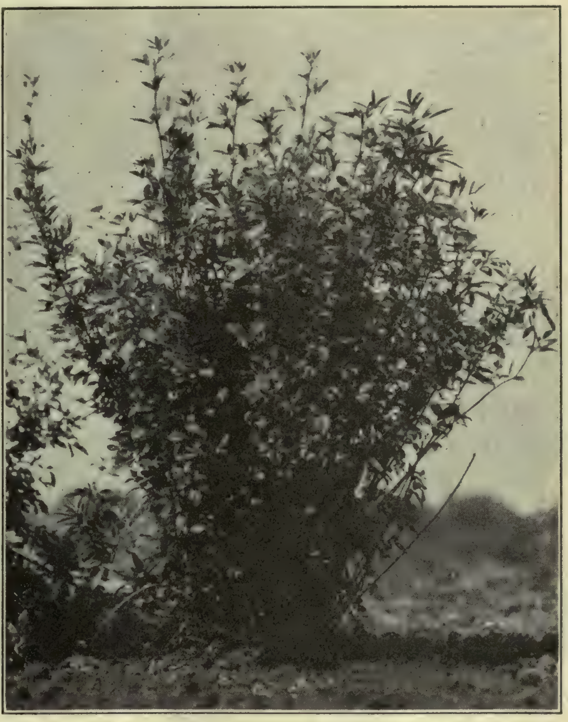
FIG. 4.—A typical plant of Arabian alfalfa.

At the present time the acreage in Arabian alfalfa in the United States is comparatively unimportant, and results secured in most cases indicate pretty clearly that this variety, all things considered, is not equal to either the Peruvian or ordinary alfalfa for general use, even in those parts of this country to which it is best adapted.

YELLOW-FLOWERED GROUP.

In this group are included the various forms of the yellow-flowered species,[1] sometimes referred to as Siberian alfalfas. This term, however, is misleading, since not all of the yellow-flowered alfalfas come from Siberia. While these alfalfas are of comparatively little agronomic importance at the present time, they have been so extensively exploited that it is deemed advisable to discuss them along with the important commercial varieties of alfalfa.

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[1] *Medicago falcata.*

The first importation of any of the forms of yellow-flowered alfalfa of which there is a record was made by the Department of Agriculture in 1898. Accidental introductions, however, occurred before that date. Since 1898 numerous lots of seed have been procured from various parts of Europe and Asia. The plants from these importations vary greatly in their characteristics, including habit of growth. Most of them are procumbent (fig. 5), while a few are nearly as erect (fig. 6) as the ordinary purple-flowered alfalfas. Few, if any, of the forms possess true taproots, but have a much-branched root system. In general, the crowns are produced somewhat below the surface of the ground, a protective adaptation which enables the plant to endure cold and drought. The flowers are yellow, and the seed pods are crescent or sickle shaped.

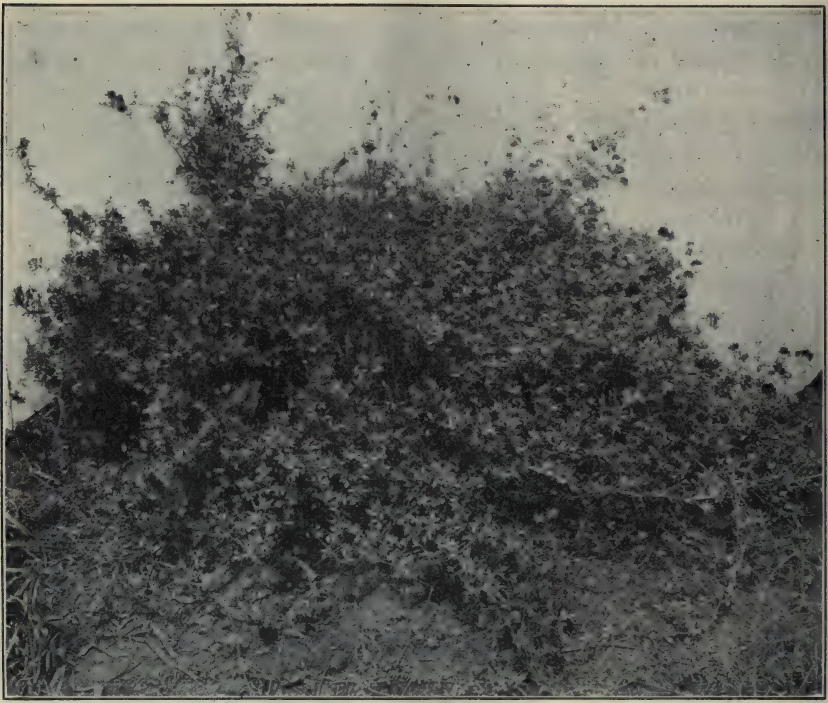

FIG. 5.—Yellow-flowered alfalfa (*Medicago falcata*), decumbent type.

The Department of Agriculture has tested many forms of the yellow-flowered alfalfa quite thoroughly in various parts of the country. The results of these tests lead to the conclusion that their chief value is for hybridizing with the purple-flowered alfalfas in order to produce hardy and drought-resistant strains. It is believed that of themselves they are not sufficiently productive to be profitable under cultivation, since they rarely give more than one cutting in a season. Furthermore, most of the forms are not sufficiently erect to be harvested for hay by field machinery, and almost without exception they produce seed very scantily. A few of the best forms of the yellow-flowered alfalfa give one cutting of hay that frequently outyields the first crop of the ordinary commercial varieties. However, the higher yield in this one crop does not offset their failure to produce more than one cutting in a year.

For use on uncultivated pasture and range lands the tests so far indicate that these alfalfas are not sufficiently aggressive to be of much value. In fact, it is very doubtful whether even a scattering stand of plants would survive on the average dry range, even if careful attention were given to seeding.

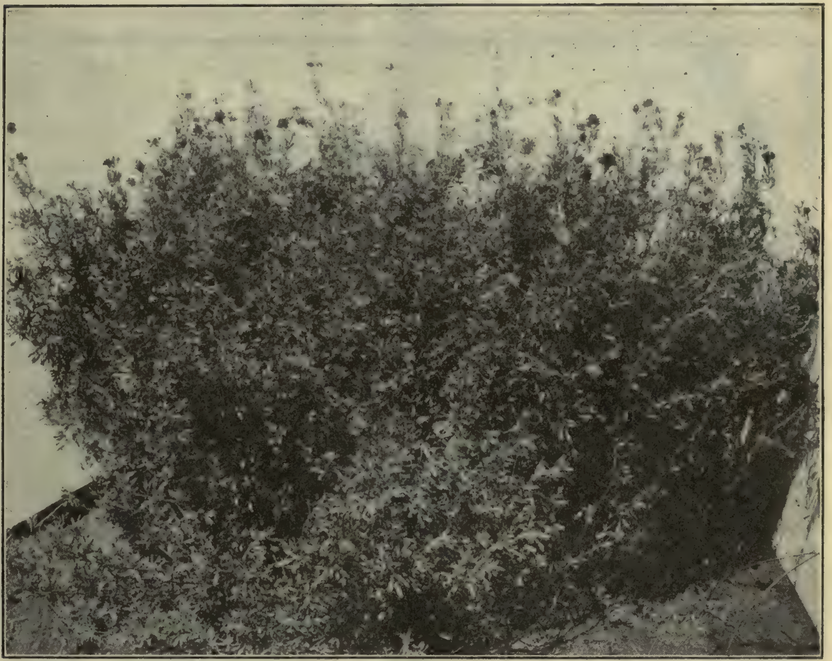

FIG. 6.—Yellow-flowered alfalfa (*Medicago falcata*), one of the more erect forms.

The Department of Agriculture advises farmers to go to no great trouble or expense in testing these yellow-flowered alfalfas at the present time, since there is still much work for plant breeders to do before they can be advantageously utilized.

There are two forms or, rather, two importations that have received considerable attention by reason of being extensively advertised in agricultural journals. They are known as the Semipalatinsk and Orenberg, receiving their names from the Provinces in Siberia and Russia from which they were imported. While these lots are superior in some respects to many other forms of the yellow-flowered alfalfas, they are composed of mixed strains and are subject to the same objections that apply to the group as a whole.

VARIETIES OR STRAINS FOR VARIOUS SECTIONS.

In recent years numerous tests have been conducted in all parts of the United States with alfalfas from various sources. These tests have had as their main object the determination of the variety or strain that can be most profitably grown in a specific locality or under certain conditions. As a result of extensive tests it is now possible to designate with considerable definiteness the part of the country where each of the various commercial strains or varieties may be expected to give the most satisfactory results. (Fig. 7.) There are, however, more or less extensive areas in all parts of the United States where the conditions are so unfavorable to alfalfa that an attempt to produce any of the known varieties or strains is almost certain to result in their failure to grow or in their inability to give profitable yields.

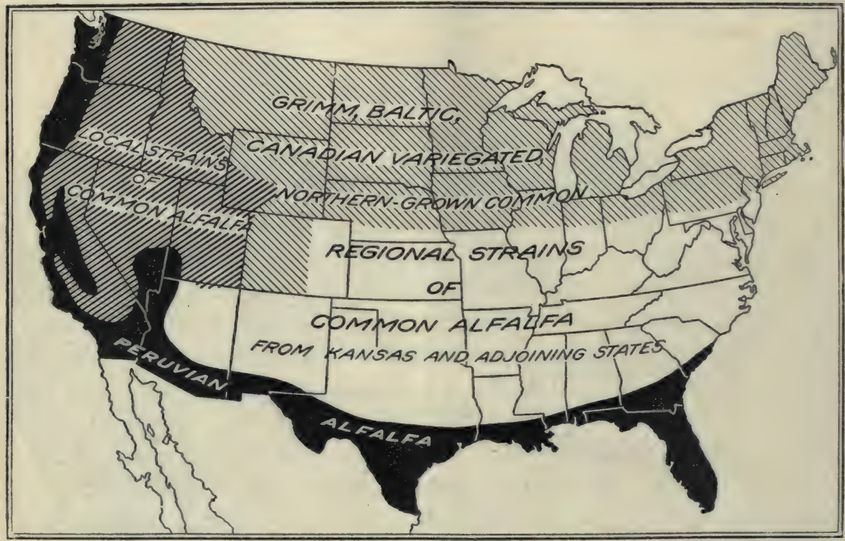
GRIMM, BALTIC,
CANADIAN VARIEGATED,
NORTHERN-GROWN COMMON
LOCAL STRAINS OF COMMON ALFALFA
REGIONAL STRAINS OF COMMON ALFALFA FROM KANSAS AND ADJOINING STATES
PERUVIAN ALFALFA

FIG. 7.—Outline map of the United States, showing the varieties or strains of alfalfa that are recommended for various sections, based upon climatic conditions.

In choosing a variety or strain it is well to bear in mind that the quick-growing alfalfas, because of their tendency to produce heavier yields, should be used as far north as they will survive the winters.

The variegated alfalfas, including the Grimm, the Baltic, and the Canadian variegated, have usually proved more resistant to severe winter conditions than the ordinary strains and therefore give the most satisfactory results where winterkilling is a serious factor. They are not to be recommended generally, however, for conditions where ordinary alfalfas will succeed, owing to the higher cost of the seed and to the fact that they have a tendency to yield less than the latter under such conditions. As a rule, they may be expected to give the best results in the following States and localities: New England States, New York, Michigan, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Montana, Nebraska, northern Illinois, Indiana, Ohio, the greater part of Pennsylvania and Wyoming, and the western half of Colorado. There are, however, areas in several or all of the States mentioned where the soil or climatic conditions are exceptionally favorable to the growth of alfalfa and where the common alfalfa will give more profitable returns. Such areas occur on the limestone soils of New York, Michigan, Wisconsin, and Ohio, as well as parts of Massachusetts, Rhode Island, Connecticut, and Long Island where the climate is modified by proximity to the ocean, thus reducing the losses from winterkilling. If difficulty is experienced in obtaining seed of the Grimm, Baltic, or other hardy variegated varieties for the northern part of the United States, it is recommended that seed of some good northern regional strain be procured. For such conditions these strains generally have proved to be superior to those from farther south.

In sections having very mild winters Peruvian alfalfa has proved more profitable than any other commercial variety or strain, owing to its ability to produce considerably heavier yields. Usually it can be grown to advantage only in sections where the minimum temperature is not lower than 10° F. and where ordinary alfalfa will succeed. The section to which this alfalfa is adapted includes the western portions of Oregon and Washington; the greater part of California, except the mountainous portions; southern Arizona; southern New Mexico; southern Texas; and a strip of country bordering on the Gulf of Mexico and extending northward along the Atlantic Ocean, finally ending in the vicinity of Charleston, S. C. In all the great belt of country lying between the area on the south where Peruvian alfalfa has proved most profitable and the line on the north marking the southern limit of serious winterkilling and extending westward from the Atlantic Ocean to the Rocky Mountains, the common strains that have been developed in Kansas, Oklahoma, Texas, and under similar conditions have given the most satisfactory results. They are somewhat more satisfactory for this area than the common strains from the intermountain region.

In the intermountain region, which embraces practically all the United States not included in the three preceding regions, seed from locally developed strains generally gives as satisfactory results as that from other sections of the country, although here, too, in some of the valleys having high altitudes the Grimm and Baltic alfalfas are preferred. The States or parts of States falling in this group are Idaho, Nevada, Utah, southwestern Wyoming, the mountainous portions of California, and the greater part of Oregon and Washington.

PURCHASING SEED.

Before buying alfalfa seed there are three points upon which the purchaser should have information: The name of the variety, the section of the country in which it was produced, and the quality of the seed with regard to both germination and purity. Unfortunately, it is not possible to distinguish between varieties or strains of alfalfa by the appearance of the seed, and the tests that so far have been developed to assist in this connection are not of much practical value to the farmer. Except in the case of imported Russian Turkestan seed, there is no easy means of telling from the appearance of a sample of seed where it was grown. It is important, therefore, that dealings be had only with thoroughly reliable and intelligent seedsmen and growers.

The viability of the seed, or its ability to germinate, is quite clearly indicated in its appearance. Plump seed of a bright olive-green color almost invariably germinates well, while shriveled seed or seed that is of a brownish color usually germinates poorly. With age alfalfa seed turns a reddish brown color, and while some viable seed may possess this color, such seed should not be purchased even if it is offered at a price materially less than that asked for seed of a fresh olive-green color. When a germination test is desired it can be made by placing 100 seeds between cloths or blotting paper and keeping them moist and at a temperature of about 70° F. After five or six days most of the readily viable seeds will have sprouted. There will be some, however, that will remain hard, especially if they are of the variegated varieties. Many of these hard seeds will grow when put in the ground, and therefore they should be considered in estimating the percentage of germination. The Department of Agriculture, through its main Seed Laboratory and branch laboratories, is prepared to make a limited number of germination tests free of charge, but in order to prevent delay samples should be mailed to the department at least two months in advance of seeding time.

With regard to the purity of alfalfa seed, every farmer should be able to recognize readily the most important weed seeds and other impurities that are commonly found in it. Seed to be acceptable should contain not more than 2 per cent of impurities. At the present time there is almost no attempt to adulterate alfalfa seed in this country, but every lot should be very carefully examined for seed of noxious weeds, especially dodder, before it is purchased. The seeds of dodder are smaller than those of alfalfa, more nearly round, and have a pitted surface which can be detected only by the aid of a lens. As dodder is a very troublesome weed and its seeds can not readily be separated from alfalfa seed, dodder-free seed should be demanded by the purchaser. Seeds of buckhorn should always be looked for when samples of alfalfa seed are examined before purchasing. These seeds are shiny brown in appearance, boat shaped, and about twice the length of the alfalfa seed. Seed of Russian knapweed, which has previously been described, should also be searched for carefully, as its presence indicates the imported Turkestan variety. (See fig. 2.) While the Seed Laboratory of the Department of Agriculture is prepared to make a purity analysis of a limited number of samples free of charge for private individuals, it is very desirable that every farmer acquaint himself with the impurities and noxious weed seeds that alfalfa seed commonly contains, in order that there may be no serious delay in purchasing seed for sowing.

SEED PRODUCTION.

The commercial production of alfalfa seed in this country is confined almost exclusively to that portion lying west of the one hundredth meridian where irrigation and dry-land farming are practiced. Alfalfa does not produce seed satisfactorily under humid conditions, and therefore it is not profitable in a vast majority of cases to attempt to grow seed in the Eastern States. It is true that there are limited areas in these States where comparatively small quantities of alfalfa seed are produced, but they are exceptions. Ordinarily it is very much more profitable for the eastern farmer to purchase seed that is produced in the West rather than to attempt to grow it.

POSSIBILITIES IN BREEDING.

There are great possibilities in the breeding of alfalfa for the production of strains that will be more resistant to cold and drought or better adapted to special conditions than those that are at present in general use. However, to establish a new strain of alfalfa involves such a long period of time and so much labor and expense that farmers can hardly afford to undertake work of this kind. The breeding of alfalfa, which includes both selection and hybridization, is properly the work of the United States Department of Agriculture and the various State agricultural experiment stations, since these institutions are much better equipped for such work than private individuals. In this country most of the alfalfa breeding is, and doubtless always will be, confined largely to sections west of the Mississippi River, where the conditions are more favorable for the production of alfalfa seed.

SUMMARY.

At the present time there are recognized in the United States nine fairly distinct commercial strains of alfalfa varying in their adaptations to climatic conditions, some giving the best results in the

North and Northwest, while others succeed only in the South and Southwest, where the winters are mild.

"Common alfalfa" is a term that is used to include all of the alfalfas that are not clearly of hybrid origin or that do not have distinct and uniform varietal characteristics, such as the Peruvian and Arabian varieties. Numerous strains are coming to be recognized in the "common" group. They are often designated by the geographic name of the locality where grown, as Kansas-grown alfalfa, Montana-grown alfalfa, and many others, or by some term descriptive of the conditions under which the crop has developed, such as dry-land alfalfa, irrigated alfalfa, and nonirrigated alfalfa.

Strains developed in the South usually produce larger yields than those developed in the Northern States, but they are less hardy. The "dry-land" alfalfa seed offered on the market has so far failed to show any noticeable superiority in ability to resist drought over that grown with an abundance of moisture.

The commercial Turkestan alfalfa has been tested quite thoroughly in all parts of this country, and in nearly every case has proved inferior to American-grown strains.

The leading commercial strains of variegated alfalfa are the Grimm, the Baltic, the Canadian variegated, and sand lucern. With the exception of sand lucern, they have been found more resistant to cold than other commercial varieties or strains and are therefore recommended for sections where winterkilling occurs frequently.

Peruvian alfalfa is not resistant to severe cold and can be grown successfully only where the winter temperature is comparatively mild, as in the Southern and Southwestern States. Under favorable conditions it outyields any other commercial strain.

Arabian alfalfa is not a satisfactory variety, because of its tendency to be short lived.

As a result of numerous experimental tests the adaptations of the various varieties and strains of alfalfa have been quite definitely determined.

It is highly advisable that the farmer should learn to distinguish good from poor seed. Plump seed of an olive-green color almost invariably germinates well, while shriveled or brown seed generally germinates poorly. The presence of any appreciable quantity of weed seeds or other impurities indicates a poor quality of seed.

Owing to the fact that alfalfa does not produce seed satisfactorily under humid conditions, there is little use in trying to grow it for seed in the Eastern States.

Breeding work with alfalfa offers great possibilities, but the time and expense involved are so great that a farmer can not afford to undertake it.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1916

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 758 SEPTEMBER 6, 1916

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

MUSCADINE GRAPE SIRUP.[1]

By CHARLES DEARING,

Scientific Assistant, Office of Horticultural and Pomological Investigations.

CONTENTS.

Introduction ... 1
Varieties ... 3
Picking ... 3
Crushing ... 3
Pressing ... 4
Making the sirup ... 7
Comments and suggestions ... 9
Summary ... 11

INTRODUCTION.

The Muscadine grape[2] is a native of the southeastern United States, where the vines grow wild in the woods and produce fruit abundantly. Here and there throughout this territory, selected choice varieties are grown in vineyards ranging from a quarter of an acre to as many as 200 acres. Many farm homes in the South are provided with Muscadine grape arbors similar to the one shown in figure 1. The supply of these grapes is so plentiful on many southern farms that a considerable quantity is wasted each year. This is especially true where the farm is located at some distance from a good local market or shipping point.

This bulletin suggests how a portion of this surplus may be profitably utilized, as it has been demonstrated that a good sirup can be made from Muscadine grapes in the farm home.

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[1] The Muscadine grape-sirup investigations are the result of preliminary laboratory tests made in a small way by the Fruit and Vegetable Utilization Laboratory of the Bureau of Chemistry. In making these sirups the methods used follow closely those recommended in the Yearbook of the Department of Agriculture for 1914 (Separate 639), for making apple sirup.

The writer wishes to acknowledge indebtedness to his associate, Mr. Elmer Snyder, for assistance in the field, and to Mr. and Mrs. John H. Jefferies, of Willard, N. C., for the use of their kitchen and for other favors.

[2] Farmers' Bulletin 709, entitled "Muscadine Grapes," may be had free of charge as long as the supply lasts on application to the United States Department of Agriculture.

The Muscadine grape sirup made in accordance with the directions given on a subsequent page was found to have a delicate and unique fruity flavor. It can be used like other table sirups and is excellent with pancakes, waffles, or bread and butter. Children especially seem to like it. Its value as a flavoring adjunct or in cooking and candy making has not been tested, but, produced in the farm home, it can be made to supplement, or even replace, products requiring a considerable cash outlay.

During the fruiting season of 1915, 30 different lots of sirup were made from the Muscadine grapes grown at the cooperative experiment vineyard of the United States Department of Agriculture on the State test farm at Willard, N. C. All the utensils used in connection with the making of the sirups were purchased from merchants in a small near-by town. Wood cut on the farm was used as fuel and at the same time furnished the heat necessary for other kitchen operations. The sirup was made in the kitchen of the State test farm simultaneously with the regular kitchen work, so that the results are entirely practical. It was demonstrated that this sirup can be made in the farm home with little effort and by the use of such utensils as are found in every kitchen. The only necessary cash outlays where there is a surplus of fruit will be for (1) picking, crushing, and pressing the grapes; (2) fruit jars in which to store the finished product; and (3) a small quantity of carbonate of lime.

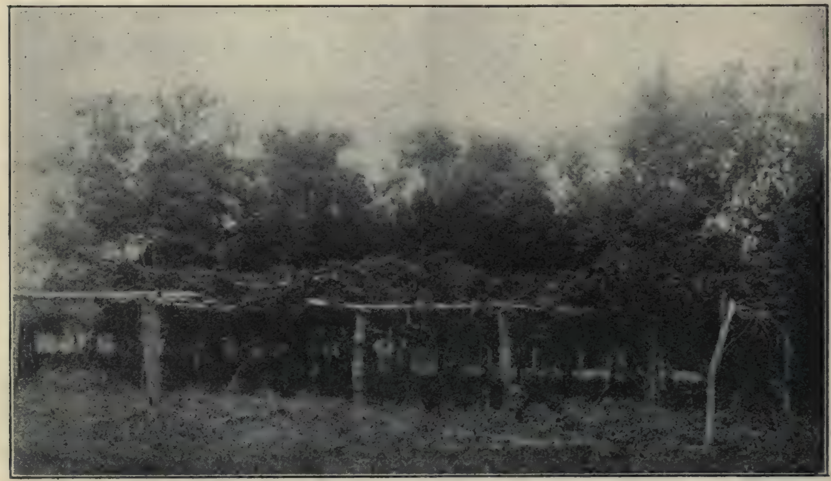
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FIG. 1.—A typical Muscadine grape arbor, such as may be found on many farms in the Muscadine grape territory. These arbors support one to several vines and sometimes cover a quarter of an acre of ground.

The unbiased opinions of many individuals in regard to the value of the experimental sirups have been obtained. These include farmers who have made sorghum sirup, farm laborers, ladies with culinary experience, children, several individuals known to have decided natural tastes for sorghum or maple sirup, specialists in sirup making and home economics, and others whose opinions were considered worth while. The unanimous opinion of nearly 100 people who tested the samples of Muscadine grape sirups made in the autumn of 1915 is that they are good; many pronounced them excellent. The best grades of sirup were estimated to be worth approximately 85 cents per gallon in comparison with sorghum sirup at 50 cents per gallon. All but two of the Muscadine grape sirups were considered equal or superior to sorghum sirup. Two of those who tried the sirups, however, pronounced themselves prejudiced in favor of sorghum sirup, ranking it higher than any of the grape sirups. Of the two samples rated below sorghum sirup, one had been scorched in cooking and the other was made from grapes of very inferior quality. The sorghum sirup used for comparison was of a make having an established reputation and was pronounced of the highest quality by the two persons who preferred sorghum sirup.

The method used in making Muscadine grape sirup is very simple, and with proper care an inexperienced operator can succeed.

VARIETIES.

The quality of the sirup made from different varieties of Muscadine grapes varies considerably. The varieties having the highest natural sugar and lowest natural acid content usually make the most delicious and highest quality sirup and also yield the most sirup per gallon of fresh juice. The Scuppernong, Thomas, Luola, Latham, Mish, George, and similar varieties of high quality make the best sirups. The James makes a sirup of fair quality, while the Flowers and Eden varieties make sirups which, relatively speaking, would be called acid and rough.

PICKING.

In picking grapes for sirup it is important to select only sound, ripe fruit. Green grapes greatly increase the acidity and reduce the quality of the finished product. Rotted or spoiled grapes impart a bitter, disagreeable taste and an unpleasant odor to the sirup.

CRUSHING.

In making sirup an ordinary cider mill may be used for crushing and pressing the fruit, but if only a small quantity of grapes is to be taken care of they may be crushed with the hands or with a wooden maul or wire potato masher. Figure 2 illustrates the inexpensive homemade outfit used in conducting these experiments. The crusher of this outfit (fig. 2, *I*) consists merely of a hopper attached to two skids of sufficient length and size to enable the crusher to rest on top of the press, as shown in figure 4, and a solid corrugated wooden cylinder located in the bottom of the hopper. When the cylinder, which is fitted with a handle and studded with small nails, is revolved, the grapes in the hopper are pulled downward between the cylinder and the side of the hopper and there crushed sufficiently to liberate the pulps from the skins. The wooden cylinder was made from a rolling-pin gouged to make parallel grooves one-half inch wide, three-fourths inch deep, and from one-fourth to one-half inch apart, running the entire length of the cylinder. It is studded with small nails about three-fourths of an inch apart, which protrude about one-fourth to one-half inch. There is a space of one-half to three-fourths of an inch between the cylinder and the inside of the hopper.

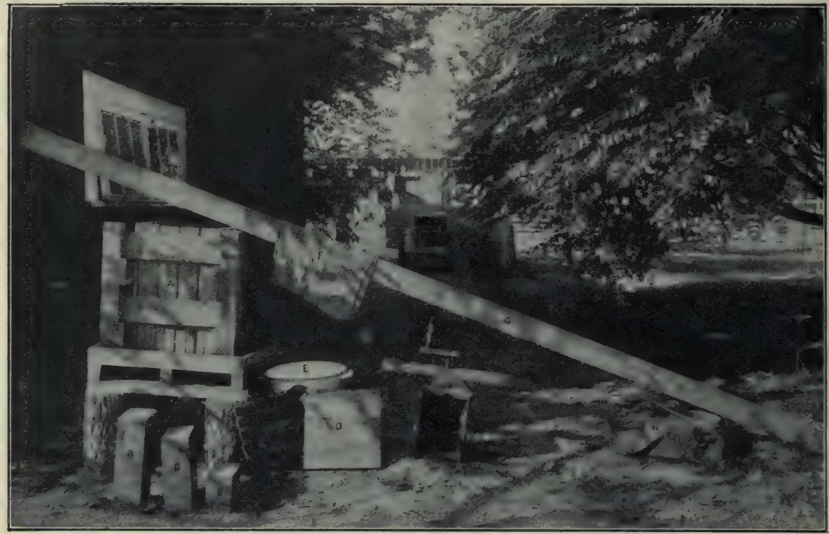

FIG. 2.—A homemade grape crusher and press used in the Muscadine grape-sirup experiments, showing its construction: *A*, Stationary part of the press; *B*, press blocks; *C*, false bottom; *D*, top, lower surface; *E*, pan to receive the juice as it flows from the press; *F*, pomace bag which holds the crushed grapes while they are being pressed; *G*, lever hinged to the building; *H*, weight to be attached to the outer end of the lever; *I*, grape crusher.

Figure 3 illustrates a grape crusher having two cylinders. A crusher of this type requires more mechanical skill in its construction, but is more effective.

PRESSING.

In the absence of a cider press, any grower who is mechanically inclined will have no trouble in making a press at slight cost. Figure 2 shows the various parts of the homemade press used in the Muscadine grape-sirup experiments, so arranged as to illustrate their construction. A forward-sloping floor with elevated sides was placed on a firm foundation. A spouted opening at the front allowed the grape juice to flow out into a container. The square basket or frame (fig. 2, *A*) erected on this floor had slatted sides. A slatted false bottom (fig. 2, *C*) was made to rest on the floor of the press inside this frame. A bag, such as is used in shipping bran (fig. 2, *F*), was suspended inside the basket, into which the crushed grapes fell. A solid block top (fig. 2, *D*), just small enough to slide easily up and down inside the frame, was placed on top of the bag of grapes. Pressure was exerted by a lever (fig. 2, *G*), and transmitted to the top of the press by means of press blocks (fig. 2, *B*, and fig. 5). The lever was made by hinging one end of a 2 by 6 inch piece of lumber, 14 to 16 feet long, to a post or building just back of the press. A weight of about 150 pounds was attached at the outer end of the beam. A rope fastened to the outer end of the lever and to trees on either side served to prevent the lever from swinging sideways; but two guide posts, erected one on either side of the lever, would serve this purpose better, as they would allow the lever more freedom in moving up and down.

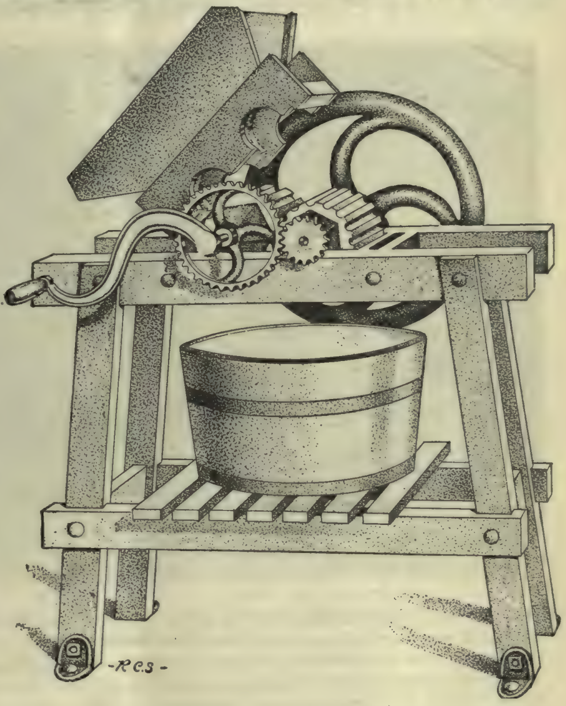

FIG. 3.—A commercially manufactured 2-cylinder crusher.

Figure 4 shows the press at a time when grapes were being crushed into it, and figure 5 shows the press while the juice was being expressed. This press was constructed from materials on the farm estimated to cost 75 cents, and a local carpenter charged 80 cents for his time, making a total cost of $1.55. Other types of farm presses could be constructed.

Before using the press for the first time, it should be scalded with hot water. This will cleanse the various parts and swell the flooring so that it will not leak. As soon as each pressing is completed, it is important to remove all pomace from the press and to wash with clean water all the parts that have come in contact with the juice. This will prevent fermentation and souring at the press and the giving of foreign flavors to later lots of juice.

The grapes should be cold pressed as soon as crushed. The free-run or first juice that comes from the press is more desirable for sirup making than that which is secured under pressure. This is principally due to the fact that the free-run juice is higher in sugar content and lower in acid content than the pressed juice. When pressure is applied, the juice flows freely at first and then at a gradually slower and slower rate for many hours, but it is not desirable to allow a batch of pomace to stand in the press longer than five or six hours. Usually it will be found most desirable to press during the day, cook the juice the first time in the late afternoon or evening, allow it to stand in the precipitating jars over night, and boil it down to a sirup the next morning. Generally speaking, a bushel of grapes will yield, when cold pressed, from 2½ to 4 gallons of fresh juice, depending upon the variety. Most varieties yield at least 3 gallons. On this basis, condensing the juice to one-ninth of its volume, which has been found to give a sirup of satisfactory consistency, 1 bushel of grapes, cold pressed, should yield 1⅓ quarts of sirup. Heated grapes yield more juice than cold-pressed grapes but make a sirup of inferior quality.

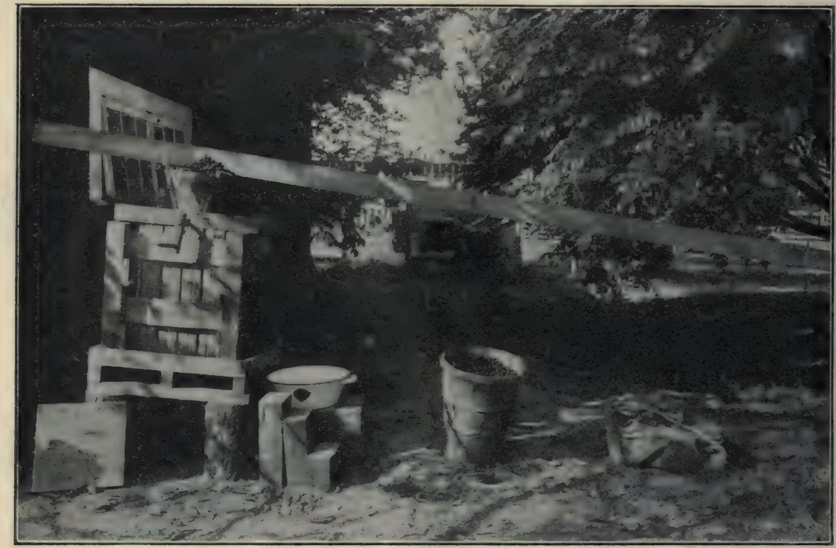
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FIG. 4.—The press set up with the crusher in place. The false bottom has been dropped into the body frame, and the pomace bag has been put in place, the top of the bag being stretched back over the two middle slats of the frame so that it remains open to receive the crushed grapes. The skids of the crusher rest on the sides of the frame, holding the pomace bag in place. The lever is resting on the top of the crusher and holds it steady while the grapes are being crushed. The crushed grapes fall directly from the crusher into the pomace bag. (Compare with figure 2.)

The labor cost for crushing and pressing the grapes, even when only a small quantity is handled, is very small if equipment similar to that illustrated in this publication is used. It is estimated that not more than 20 minutes will be required to crush and press a single bushel of grapes and to do the necessary cleaning up.

MAKING THE SIRUP.

To remove any sediment that may have accumulated while the grapes were being crushed and pressed, the juice should be strained through a double thickness of cheesecloth. For every 6 quarts of fresh, strained Muscadine grape juice, stir in 1 ounce of powdered calcium carbonate (carbonate of lime, a low-priced chemical used in sirup making to remove acids). Heat the juice and allow it to boil for about 8 minutes. It is necessary to use a container at least one-third larger than the volume of juice, in order to prevent overflowing the vessel when the juice foams up and breaks into a boil. Where a large vessel is not available the juice may be boiled in small quantities. Pour the hot liquid into tall glass containers, preferably large-mouthed fruit jars, so as to permit its condition to be observed. Allow the liquid to settle until perfectly clear and cool. It is well to let it stand over night. After the liquid is cool and clear, showing a distinct sediment at the bottom, pour off the clear portion into a cooking vessel, being careful not to pour off any of the sediment. To this clear liquid add one-sixth of a level teaspoonful of calcium carbonate for each 6 quarts of fresh grape juice which it represents.

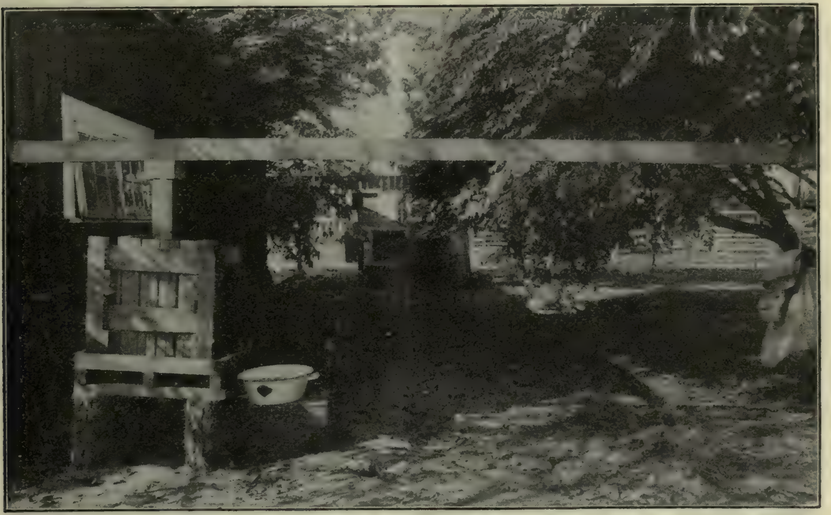

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FIG. 5.—The homemade grape press in operation. The crusher has been removed, the pomace bag folded in, the top placed on the bag, the press blocks put in place, the lever rested on them, and the weight suspended from the outer end of the lever. (Compare with figure 2.)

Complete the process of sirup making by boiling down the clear liquid, using a vessel one-third larger than the volume of the liquid. If necessary, the sirup can be completed in batches. While boiling down the liquid, keep the caramel forming on the inside of the pan wiped off with a wet cloth, so that when the nearly finished product foams up it will not carry scorched caramel into the sirup. Should any scum form during the cooking process, it should be removed with a long-handled milk skimmer. Allow the liquid to boil rapidly until nearly done and then more slowly, to avoid scorching. Cook the liquid until it reaches about one-ninth the volume of the fresh grape juice, or until a small portion cooled in a teaspoon on the surface of cold water in a cup shows about the same consistency as maple sirup or thin sorghum sirup.

When the sirup has reached the proper thickness, pour it off into glass fruit jars, cap the jars, and place them where they will cool very slowly. Slow cooling is very important in making the sirup clear, as it allows all sediment and added substances to settle completely. This slow cooling can be brought about by standing the jars of sirup in a large vessel of hot water and allowing the whole to cool, or, better still, by placing the jars in homemade fireless cookers, such as are shown in figure 6 at *A*. These are made by placing waste cotton, such as may be procured from a cotton gin, in worn-out buckets or boxes, leaving a place in the center for the hot sirup jars.

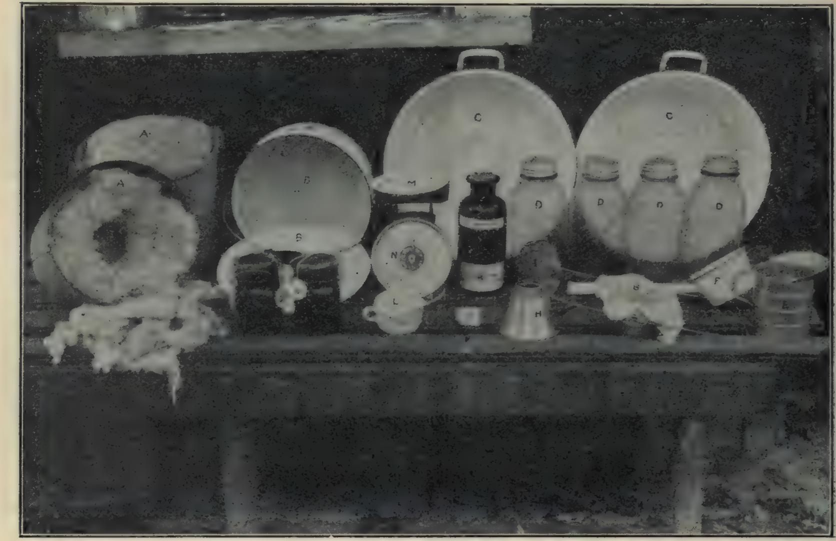

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FIG. 6.—Kitchen equipment used in making 2 pints of sirup from 9 quarts of Muscadine grape juice.

When the sirup has cooled to room temperature it can be stored in the pantry or cellar until desired for use. A small quantity of harmless white sediment, known to chemists as malate and tartrate of lime, will be observed in the bottom of the jars. When desired for use, simply pour the clear sirup into the table sirup stand, leaving the sediment, which is not easily disturbed, behind. Those who prefer, however, can pour off the clear sirup into bottles or fruit jars as soon as it has cooled and then sterilize and seal them while warm, just as with fruit. Sterilization consists merely in heating the jars of sirup to the boiling point. The jars after being filled and the caps for sealing them are placed in a pan of water, which is then brought to a boil and held at that point until the contents of the jars are approximately the same temperature.

COMMENTS AND SUGGESTIONS.

Except where glassware has been recommended it is very desirable to use only granite ware utensils in handling the grape juice and in making the sirup, for such vessels are easily cleaned. A large granite ware dish pan is probably the best container to use in boiling the liquid, for it exposes a large surface to the stove and allows rapid evaporation. If preferred, however, a granite ware wash boiler, preserving kettle, or a large stewpan may be used instead of the dish pan.

Figure 6 shows the kitchen equipment used in the sirup experiments. The use to which the various utensils were put is as follows: *A*, Homemade fireless cookers in which the jars of finished sirup were placed while hot for the purpose of making the sirup cool slowly, thus allowing the sediment and added substances to settle to the bottom of the jar; *B*, a stewpan for heating the sirup jars and for cooking part of the juice the first time; *C*, dish pans, one for catching the juice at the press and for heating the precipitating jars and the other for cooking most of the juice the first time and for cooking all the juice the second time; *D*, 2-quart fruit jars (precipitating jars), containers for the juice while clarifying between the first and second cookings; *E*, a quart cup for measuring the fresh juice, in order to determine the amount of calcium carbonate to be added; *F*, a dipper for stirring the juice during the first cooking; *G*, a strainer with cheesecloth for straining the fresh grape juice; *H*, a funnel used while pouring the juice and sirup into jars; *I*, a long-handled milk skimmer for skimming the boiling sirup; *J*, a wet cloth for wiping the caramel formation from the inside of the pan while the sirup is boiling down; *K*, a bottle of calcium carbonate, the cheap chemical used in sirup making; *L*, a cup of water and a teaspoon for testing the sirup to determine when it is done; *M*, a saucer in which to weigh the calcium carbonate; and *N*, scales for weighing the calcium carbonate. The finished product is shown in two glass jars (*O*).

Calcium carbonate (carbonate of lime) is used in sirup making for the purpose of removing acids. In the presence of heat it combines chemically with the acids of the grape juice to form compounds which precipitate as sediment or crystallize against the sides of the precipitating jars when the liquid is placed in them to cool after the first boiling. This chemical can generally be obtained from a local drug store, and even if it is not in stock the druggist can order it from a druggists' supply house. There are many natural forms of calcium carbonate of greater or less purity; for example, shells, limestone, marble, marl, and chalk. The commercial forms recommended for use in sirup making are chemically pure calcium carbonate, commercial calcium carbonate, powdered precipitated chalk, and powdered marble dust.

There is also a commercial carbonate of lime used by painters which is known as whiting. This is very cheap, costing approximately 1 cent per pound. Whiting is, however, recommended for use in sirup making only when it can be obtained in the original package in which it was put up by the manufacturer, for in a paint store an opened package is susceptible to contamination by such harmful impurities as white lead and Paris green.

A slight excess of carbonate of lime added to the grape juice in sirup making will do no harm, but generally 1 ounce to each 6 quarts of fresh grape juice will be sufficient to remove the acids. Should the grape juice be relatively high in acid content, however, it would be advisable to add from 1¼ to 1½ ounces of carbonate of lime for each 6 quarts of fresh juice before the first boiling.

When the grape juice is first heated it is well to stir it occasionally, but too much stirring seems to increase foaming. As the juice is coming to a boil a heavy foam will form on the surface, rise up, break away, and then subside. As this foam which develops previous to boiling contains free carbonate of lime it should not be skimmed off. The combining of the carbonate of lime with the grape-juice acids gives to the liquid a greenish tinge, which disappears with the precipitation of sediment after the first boiling.

In order to avoid breaking the precipitation jars and also the fruit jars when receiving the finished sirup, it is necessary to heat them to approximately the temperature of boiling water. This can be done very easily by immersing the jars in hot water.

While it is desirable to allow the liquid to boil rapidly during the cooking process, it is not advisable to remove the lids from the stove in order to have the pan next to the fire, for in this case the heat will be concentrated too much and will scorch the sirup.

It is difficult to describe the stage in the process when the sirup has been boiled down sufficiently, but the sirup maker can easily determine this after one experience. The aim should be to remove the liquid from the stove when it has reached the consistency of a thin sirup. An experienced cook can judge this rather accurately by dropping the liquid from a spoon. The best test, though, is occasionally to take a little sirup in a teaspoon and hold this on the surface of some cold water in a cup, so as to cool it. The cooled sirup in the spoon can then be felt with the finger and its thickness judged.

For keeping Muscadine grape sirup, wide-mouthed fruit jars of pint and quart sizes will be found satisfactory.

In making Muscadine grape sirup the juice of the varieties of grapes mentioned on a foregoing page as being best adapted for sirup will need no sugar; in fact, they should not have sugar added. The sirup of acid varieties like the Flowers and Eden, however, will be improved by the addition of some sugar; say, from one-half to 1 pound for each 6 quarts of juice. The experiments show that the addition of one-half pound of ordinary cane sugar to 6 quarts of Flowers grape juice is equal to the addition of 3 extra quarts of fresh juice of the same variety, in terms of the quantity of sirup produced. The time to add the sugar is just before the second cooking. In this connection attention should be called to the Federal pure-food standards, which require that when a fruit sirup to which sugar has been added is offered for sale in interstate commerce the container must bear a label stating that fact.[1]

SUMMARY.

A good table sirup can be made in the home from Muscadine grapes.

Muscadine grapes thrive in the southeastern United States, and the homes of that section are generally plentifully supplied with the fruit.

The sirup can be made from surplus fruit which is usually allowed to go to waste.

Only the inexpensive equipment illustrated and described in this bulletin is required, and the method is so simple that a person should succeed on the first attempt.

Generally speaking, the process of making the sirup consists of the following steps: (1) Harvesting the fruit and extracting the juice, (2) boiling with calcium carbonate, to reduce acidity, (3) precipitating the acidified carbonate, or clarifying the juice, (4) boiling down the cleared juice to a sirup of the desired thickness, and (5) canning or bottling the sirup.

Varieties of Muscadine grapes having a high sugar and a low acid content make the best sirup.

A bushel of Muscadine grapes will yield from 2¼ to 4 gallons of fresh juice, depending on the variety. Most varieties, especially those best suited for sirup making, yield over 3 gallons of fresh juice.

In condensing the juice to one-ninth of its original volume to make a sirup of satisfactory consistency, 1 bushel of Muscadine grapes should yield approximately 1⅓ quarts of sirup.

Muscadine grape sirup is considered by many as good as or better than other sirups usually found upon the table.

As Muscadine grape sirup is usually made from home-grown fruit it can be used to supplement or even replace a direct expenditure of money for other sweets.

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[1] Standards of purity for food products. U. S. Dept. Agr., Off. Sec. Cir. 19, 19 p., 1906.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 759 OCTOBER 9, 1916

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

"WHITE ANTS"[1] AS PESTS IN THE UNITED STATES AND METHODS OF PREVENTING THEIR DAMAGE.

By T. E. SNYDER,

Specialist in Forest Entomology, Forest Insect Investigations.

CONTENTS.

	Page.
Introduction	1
Description and habits of white ants	2
Life cycle of white ants	4
The swarm	4
Damage to woodwork of buildings and to other timber	5
Damage to stored material	8
Damage to fruit, nut, shade, and forest trees	9
Damage to field crops and grazing land	10
Damage to nursery stock, young plantation stock, and vineyards	11
Damage to shrubs, flowers, and greenhouse stock	12
Protection of woodwork in buildings	12
Protection of stored material	17
Protection of living trees	18
Protection of nursery stock, vineyards, and field crops	18
Protection of flowers and greenhouse stock	18
Summarized recommendations for protection of woodwork in buildings	19

INTRODUCTION.

The serious damage which "white ants," or termites, cause to a great variety of wood products, as well as to growing plants, can be prevented. This publication gives a brief account of these insects, their habits and damage, and shows how losses from this source may be avoided. The most serious damage by white ants is that caused to foundation timbers and the woodwork of buildings and to the material stored therein. Similar damage to other construction timber in contact with the ground is considerable, especially in the Southern States.

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[1] The species principally treated herein are *Leucotermes flavipes* Kollar, *L. virginicus* Banks, and *L. lucifugus* Rossi.

Injury to living trees and shrubs, growing crops, or other vegetation is only occasional and local and usually occurs because the land has been cleared recently and there is much decaying wood and humus in the soil. There are several kinds of termites, or white ants, in the United States, but those which are best known and most commonly reported as injurious belong to three small, closely related, and very similar species [1] of more or less general distribution.

DESCRIPTION AND HABITS OF WHITE ANTS.

"White ants" are not true ants, although they are superficially antlike and live in colonies made up of different forms or castes and are social insects. In these nests or colonies both wingless and winged mature individuals are produced. The brownish, or blackish, elongate, slender, antlike, sexed adults (fig. 1) with long white wings, unlike the other forms, have functional eyes and are able to endure full sunlight. These migratory males and females appear normally only once a year during a short period. The grayish-white, soft-bodied, wingless "workers" (fig. 2) are in reality the destructive form. These workers make the excavations and enlarge and extend the colony as this becomes necessary. They live underground and shun the light and are therefore rarely seen. The soft-bodied, wingless "soldiers" (fig. 3), which have an elongate, narrow head armed with long, slender, saber-shaped jaws, and the workers are the most

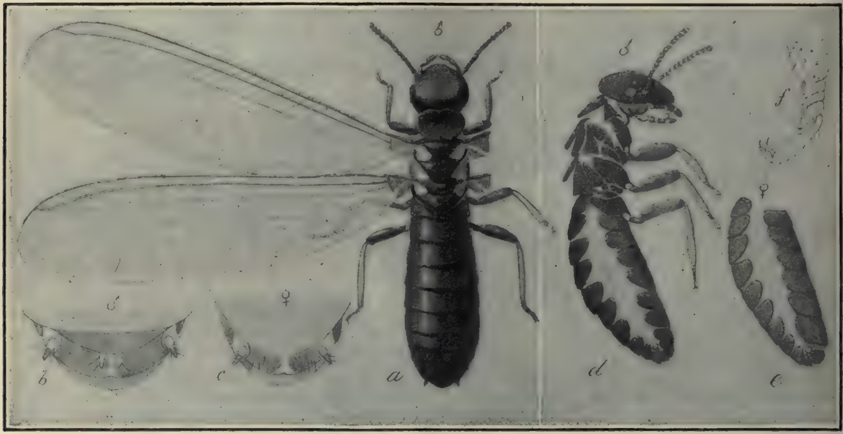

FIG. 1.—Winged forms of the white ant known as *Leucotermes flavipes: a*, Adult male; *b*, terminal abdominal segments from below; *c*, same of female; *d*, male, side view, somewhat inflated by treatment with ammonia; *e*, abdomen of female, side view; *f*, tarsus, showing joints and claws. *a, d, e*, Enlarged; *b, c, f*, greatly enlarged. (Marlatt.)

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[1] *Leucotermes flavipes* Kollar, *L. virginicus* Banks, and *L. lucifugus* Rossi; order Platyptera, suborder Isoptera, family Mesotermitidæ.

numerous forms permanently present in the colony. Other forms in the colony are the reproductive individuals; in some colonies these consist of a single pair, the normal king (fig. 4) and queen (fig. 5), while in other colonies many supplementary nymphal (fig. 6) or larval types may be present. These reproductive forms never reach the size attained by those of certain species of termites in the Tropics and never lose the power of movement.

White ants are essentially wood destroyers and live in nests in the wood of dead trees, decaying logs, or stumps in the forest; in the foundation timbers of buildings, fences, or other structures of wood in contact with the ground; or in a labyrinth of underground passages in the earth, usually underneath wood or other vegetation. An average colony contains several thousand individuals. Owing to their subterranean habits and often countless numbers, it is sometimes very difficult to destroy them when once they are established in a building. Always coming up through underground galleries, they work in the interior of the wood and leave intact a protective outer shell, so that the damage is often unsuspected until beyond repair.

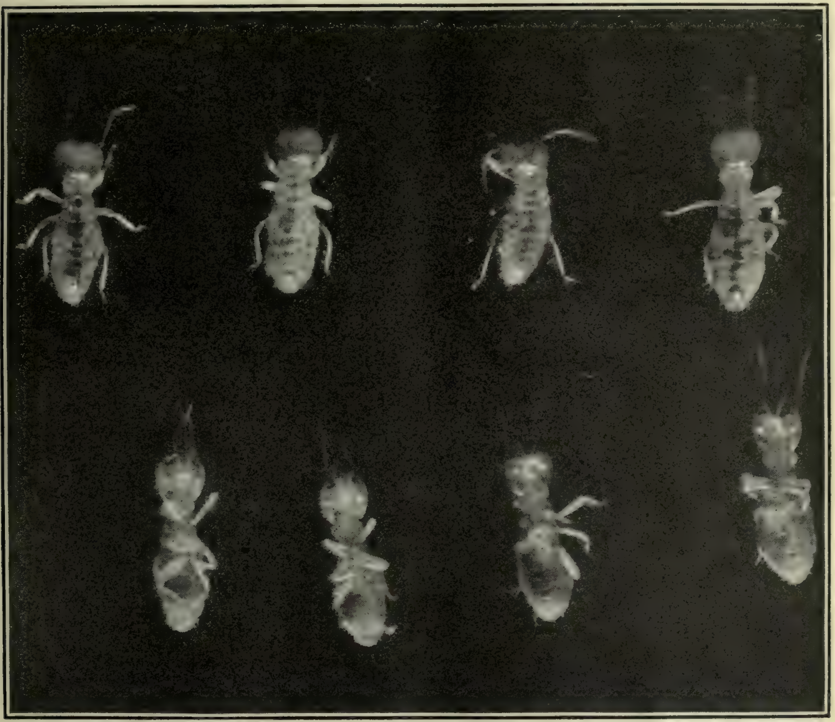

FIG. 2.—Mature "workers" of the white ant known as *Leucotermes flavipes;* etherized specimens. Enlarged nearly six times. (Original.)

LIFE CYCLE OF WHITE ANTS.

There are three stages in the life of white ants; namely, the egg, the immature form (larvæ, or nymphs), and the mature individual (including workers, soldiers, and the various reproductive forms).

Egg laying occurs over a considerable period of time during the warm months in colonies out of doors, but in infested buildings where an even temperature is maintained, especially those occupied by man, the insects are active and egg laying may occur during every month of the year. The number of eggs laid by each reproductive form depends on its age.

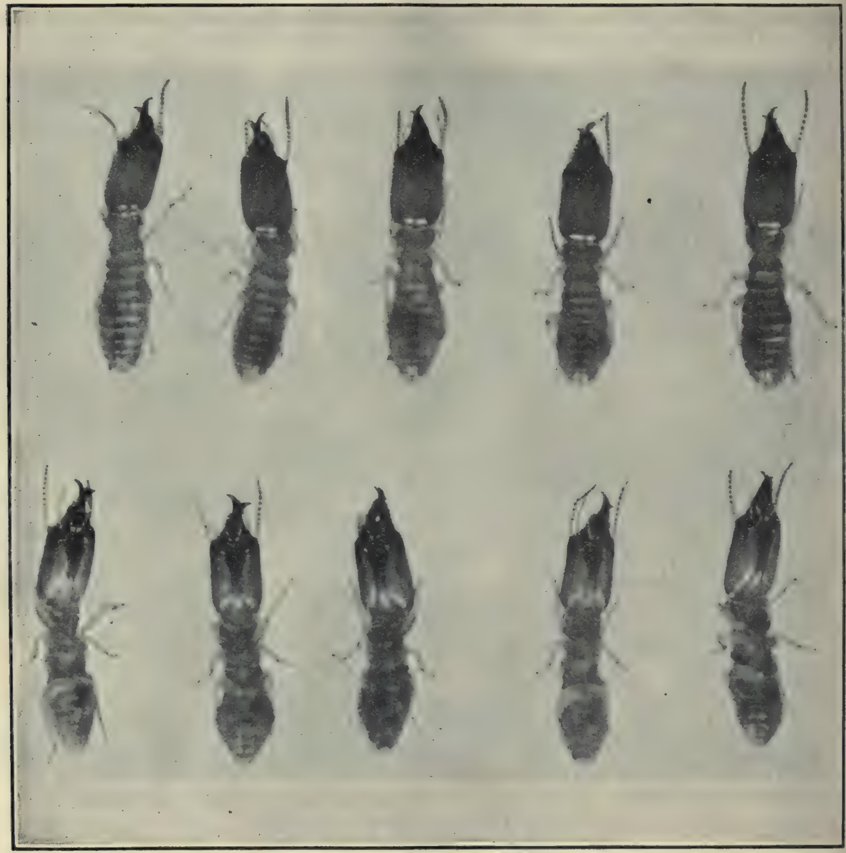

FIG. 3.—Mature "soldiers" of the white ant known as *Leucotermes flavipes;* etherized specimens. Enlarged nearly six times. (Original.)

THE SWARM.

At a certain season of the year the winged, sexed individuals migrate in large numbers from the parent nests to found new colonies. The season during which swarming takes place varies with the species and the geographical locality, usually occurring in the spring or fall. There are often several swarms from the same nest, sometimes as many as four separate swarms, extending over a period of one month. In infested buildings the winged males and females usually swarm a month or more earlier than outdoors, and the more common species[1] was observed to swarm as early as the middle of February in infested buildings in Washington, D. C. Numerous urgent requests are received by the Department of Agriculture for information in regard to these "flying ants" in buildings.

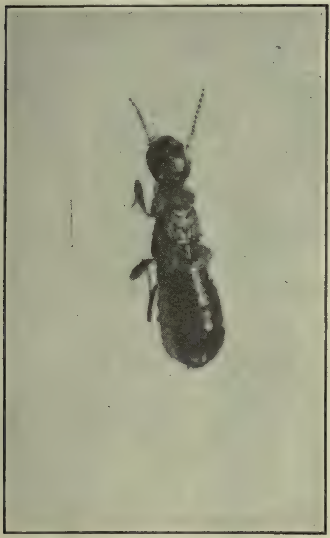

FIG. 4.—Mature "king" of normal form of the white ant known as *Leucotermes flavipes;* several years of age. Etherized specimen, enlarged six times. (Author's illustration.)

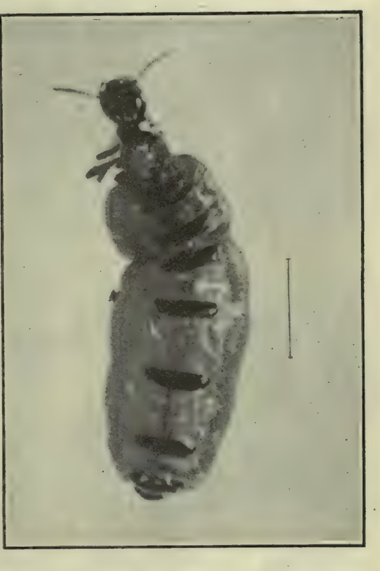

FIG. 5.—True "queen" of the white ant *Leucotermes flavipes,* with wing stubs and chestnut-colored hard parts. Etherized specimen, enlarged six times. (Author's illustration.)

DAMAGE TO WOODWORK OF BUILDINGS AND TO OTHER TIMBER.

Damage to foundation timbers, flooring in basements, and other woodwork of buildings,[2] both in rural regions and in large cities, is common and often serious in the southern portions of the United States, especially in the South Atlantic and Gulf States. Injury of this type, however, has been recorded as far north as Manchester, N. H., and the shores of the Great Lakes (Benton Harbor, Mich.).

White ants live in wood which is in contact with, or can be reached from, the ground. The workers are able to travel comparatively long distances through subterranean galleries in search of wood and in extending their colonies, and usually gain entrance to buildings from colonies outdoors. Infestation of the interior woodwork is effected from underground tunnels to and up through moist or decayed foundation timbers, flooring, or supports of porching or steps set in or on the ground.

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[1] *Leucotermes flavipes* Kollar.

[2] Such injury in the Gulf States, Southwestern States, and California is caused also by *Calotermes* spp. (fig. 7) and in Florida by *Cryptotermes cavifrons* Banks.

Beams, such as joists, studding, stringers, and other foundation timbers in the basement or cellar, even though entirely inclosed or embedded in concrete, are but partially protected from attack by termites. In the settling of the structure, or in weathering, concrete is almost sure to crack and allow moisture and insects to enter. Furthermore, beams and joists put down in moist concrete decay rapidly and become exceptionally good breeding places for these insects; from such beams white ants carry their burrows up through the timbers to the first, second, and even third floors.

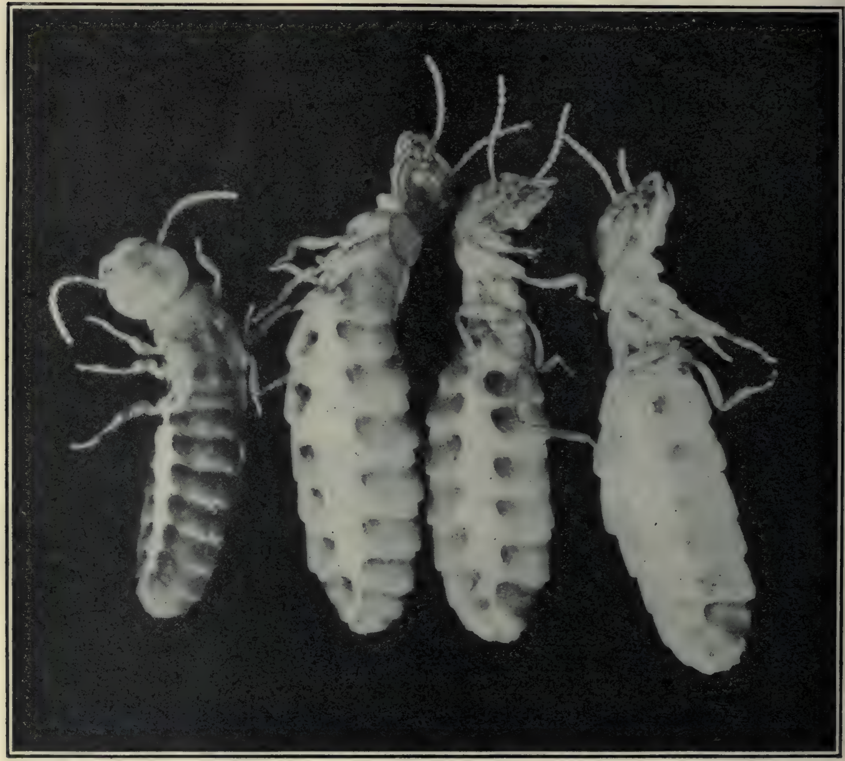

FIG. 6.—Supplementary nymphal reproductive forms of the European white ant *Leucotermes lucifugus*; one king and three queens. Colorado Springs, Colo. Enlarged 10 times. (Original.)

Flooring (fig. 8) and other stationary woodwork and furniture frequently become infested when the wooden beams are laid directly on the earth or in moist concrete; they are often reduced to mere shells, the interior being completely honeycombed. Termites usually follow the grain when working in solid wood.

Termites are able to extend their burrows throughout dry, hard wood and other dry substances far removed from the ground, and over impenetrable material, provided there is access to moisture elsewhere, i. e., damp earth. They make use of a mixture of moist earth and finely digested, excreted wood in creating more favorable conditions of moisture and shelter while extending their galleries. White ants prefer to work in dark, warm, moist places.

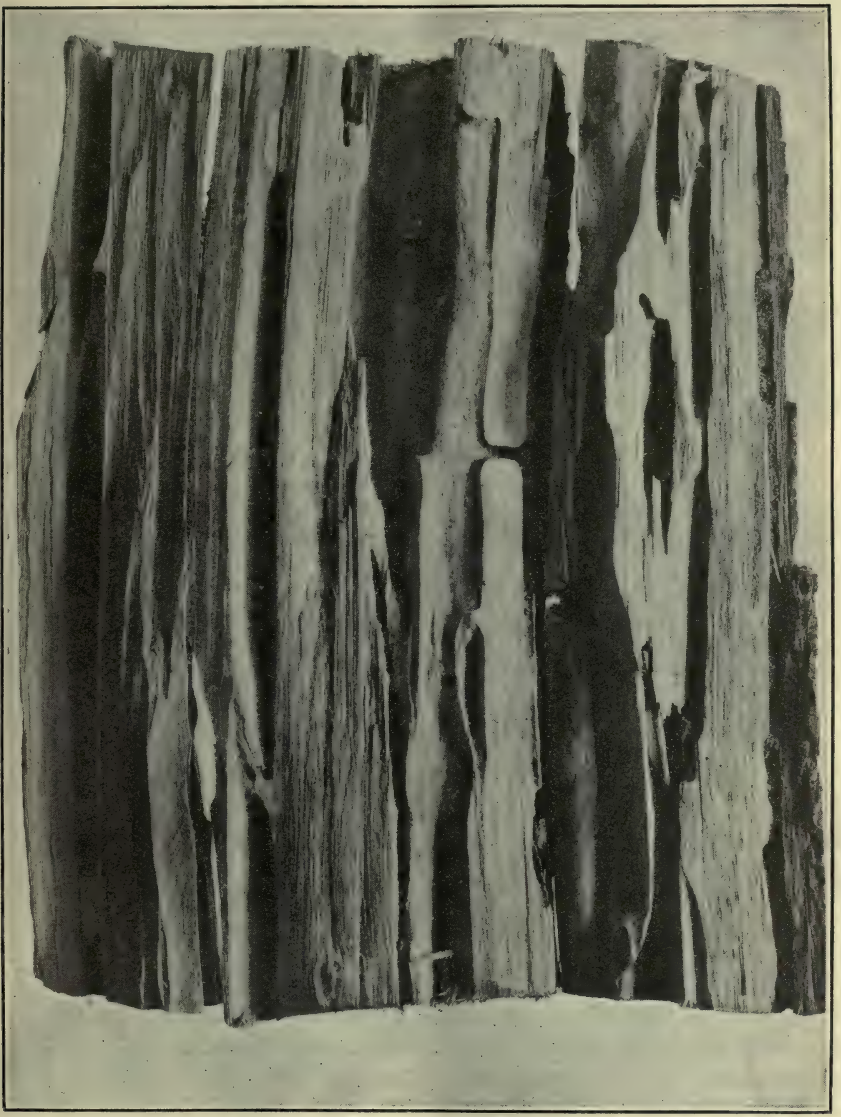

FIG. 7.—Work of a western white ant, *Calotermes* sp., in Mexican walnut. Catalina Mountains, Ariz. (Original.)

Termites even pass over substances they can not penetrate, such as metal or stone, brick, or concrete foundations, by means of small shelter sheds or granular, earthlike tubes constructed of earth and excrement extended up from the ground.

Any wood construction in contact with the ground is especially liable to attack by white ants. Among these may be listed construction timber in bridges, wharves, and similar structures, telephone and telegraph poles,[1] mine props, railroad ties, posts, lumber piled on the ground, wooden boxing for cables, cypress water tanks, etc.

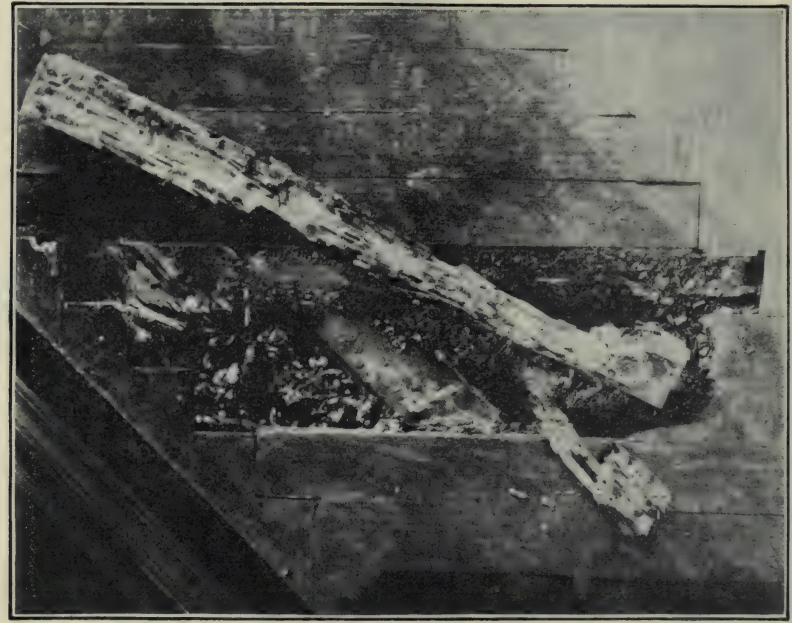

FIG. 8.—Oak floor honeycombed by white ant *Leucotermes flavipes*. Washington, D. C., July, 1915. Photograph by C. H. Popenoe. (Author's illustration.)

DAMAGE TO STORED MATERIAL.

Of the stored material sometimes seriously injured or destroyed by termites may be mentioned wooden electrotype blocks and other wood products, books or papers in libraries or elsewhere (fig. 10), valuable documents (fig. 11), wood-pulp products, pasteboard, rolls of cloth and other fabrics, clothing, shoes and other leather products, as well as food stored on shelves or on the floors in dark, damp basements or cellars, or similar moist places where the ventilation is poor.

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[1] In California damage to poles by *Termopsis angusticollis* Walker (fig. 9), and in the Gulf States by *Calotermes* spp. also occurs.

DAMAGE TO FRUIT, NUT, SHADE, AND FOREST TREES.

Termites occasionally injure living trees and shrubs. In Florida they have caused considerable damage to newly planted groves of orange trees, having eaten away the bark about the collar and root and completely girdled the trees. Similar damage by white ants has been recorded to other fruit trees, as apple, peach, pear, cherry, plum, apricot, and lemon, especially in the Southern States and in California; and also to pecan, chestnut, and walnut trees. Such damage is more common in the new soil of recently cleared woodland containing old decaying stumps or much humus.

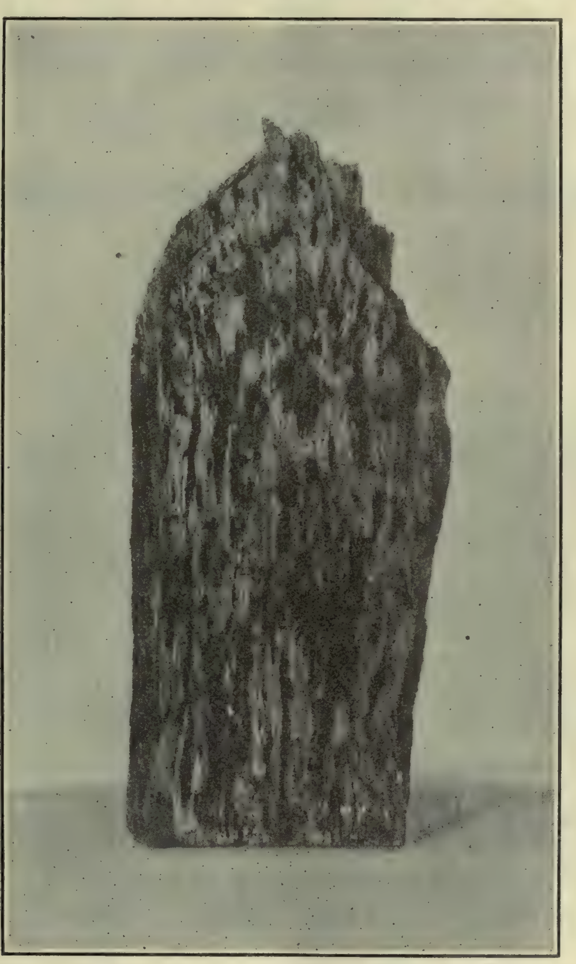

FIG. 9.—Work of a large western white ant, *Termopsis angusticollis*, in western yellow pine. Placerville, Cal. (Original.)

In cities and elsewhere, a great variety of shade trees are injured by white ants, the insects infesting the roots and the heartwood at the base of injured trees. Sometimes the infested trees are plastered with earthlike tubes or galleries.

Particularly in the South, termites render insect, fire, and disease killed timber unmerchantable, unless the timber is utilized within a reasonable period after being killed. They also damage the roots and lower trunks of injured living trees.

DAMAGE TO FIELD CROPS AND GRAZING LAND.

In the Southern States white ants occasionally injure the stems and roots of a great variety of apparently healthy field crops, including both grain and truck crops, among which may be listed corn, cotton, sugar cane, rice, grasses, potatoes, and a great variety of garden vegetables.

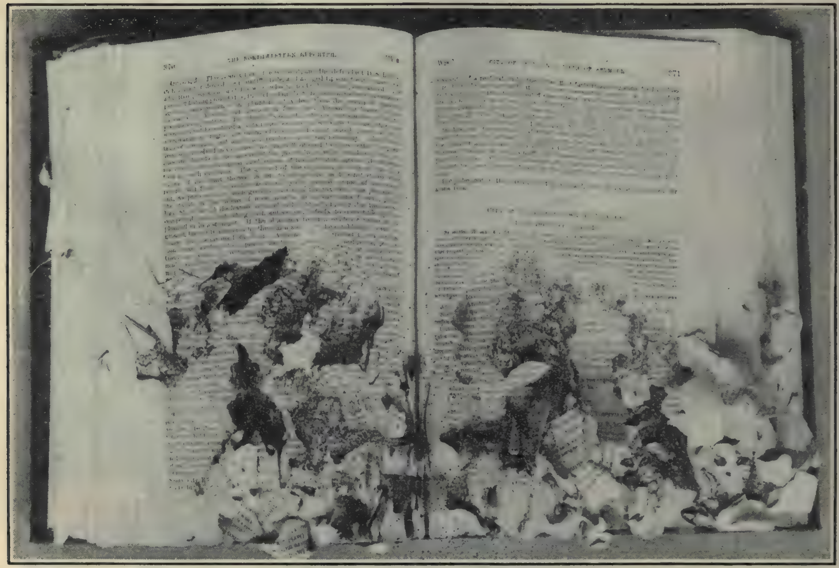

FIG. 10.—Book from library at Van Buren, Ark., ruined by white ants. June, 1915. (Author's illustration.)

Injury to corn in the prairie region of Kansas has resulted from the earlier presence of the insects in enormous numbers in the heavily sodded soil where they feed on the roots of the vegetation. Sometimes this injury to growing corn is due also to the method of plowing under old stubble.

In the prairie regions of Texas and Arizona a tube-forming termite[1] lives in the ground, feeding on the roots of grass and other vegetation, and is often found under and within dry cow dung and under stones. This species sometimes destroys the vegetation over large areas of grazing land. One of its characteristic habits is to cover the stems and roots of vegetation with tubes of small diameter, constructed of earth and excrement.

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[1] *Hamitermes tubiformans* Buckley.

DAMAGE TO NURSERY STOCK, YOUNG PLANTATION STOCK, AND VINEYARDS.

There are numerous records of termite injury to young fruit and nut tree seedlings in nurseries, to other nursery stock, and to young trees planted in recently cleared ground or soil rich in humus. The injury, however, has been only occasional and not extensive. The stock is usually attacked at a scar, where the roots have been injured or cut off, or at a graft, as cleft-graft apple stock.

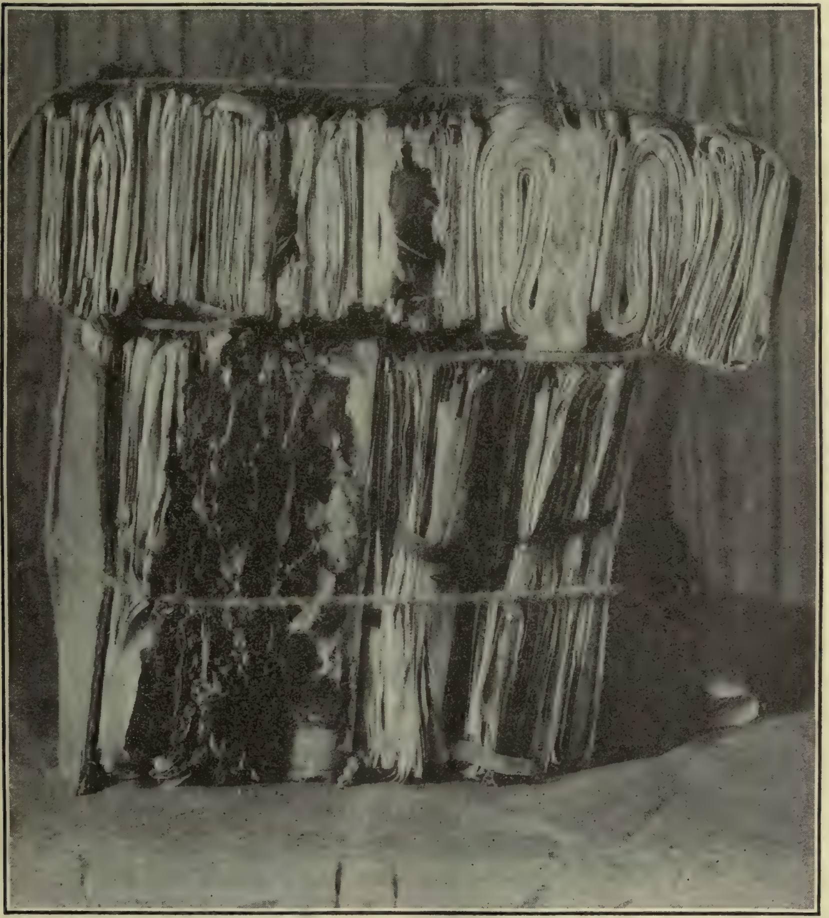

FIG. 11.—Damage by the white ant *Leucotermes flavipes* to bundles of old documents stored on tiers of wooden shelves standing on pine flooring in heated, damp, dark basement of an old building in Washington, D. C. Note how an earthlike mixture of moist earth and finely digested, excreted wood is carried into the mines of the insects in the bundles. If the connections of the termites with the ground or decayed wood, their source of moisture, be shut off, the insects perish. (Original.)

Injury by termites to vineyards has occasionally been recorded in North America. Usually only the old vines are attacked, or dead or injured parts. Signs of attack are sickly foliage or abortive buds, or the injury is observed at the time of cutting down to stock or grafting.

DAMAGE TO SHRUBS, FLOWERS, AND GREENHOUSE STOCK.

White ants injure a variety of shrubs, weeds, and flowers in gardens as well as in greenhouses. Heavily manured flower beds are a source of infestation to the stems of flowers as well as to the woodwork of houses. In greenhouses old label sticks, the wooden uprights supporting wooden benches set on or in the ground, and the wooden bench bottoms and plant pots are often attacked by white ants, and this leads to subsequent attack of the growing plants.

In the Greenhouse Insect Investigations of the Bureau of Entomology, carried on at Washington, D. C., records have been made of serious injury to many plants grown under glass, and control methods have been tried by Arthur D. Borden, who has found that heliotropes, begonias, bedding geraniums, carnations, chrysanthemums, and roses are seriously injured by white ants. One hundred and eighty out of 1,000 heliotrope plants were killed the first week after being potted from the seeding pans. As many as 75 white ants have been found in a 4-inch pot of heliotrope. The insects come up through the ground and form dirt galleries over the supports, or burrow up through the wooden bench legs and run galleries the full length of the wooden benches. They enter the soil through the drainage holes of the pots and eat out the main stalk of the root, killing the plant very quickly.

PROTECTION OF WOODWORK IN BUILDINGS.

PREVENTION OF THE DAMAGE.

Since white ants are difficult to eliminate from the woodwork of a building when once established, every precaution should be taken to prevent their gaining an entrance

In order to prevent the insects from reaching the woodwork of buildings from their nests in the ground, the foundations should, where possible, be entirely of stone, brick, or concrete, including the pillars in the basement or cellar. The walls, partitions, and flooring in the ground floor, basement, or cellar should also be of concrete. Wooden flooring can be laid over this concrete floor if more desirable. An air space should be left between the concrete floor and the wooden floor laid over it. Concrete floors should be laid on a gravel base which will prevent dampness and cracking. The points of juncture between concrete walls and flooring should be filled in by rounding off the concrete at these places, since cracks often occur where the wall and floor join at right angles; termites often come up through cracks between walls and flooring.

The publications of the Department of Agriculture should be consulted in regard to the specifications for the proper proportioning, mixing, and placing of concrete.[1] Recent tests conducted by the Office of Public Roads and Rural Engineering have demonstrated the value of mixing a heavy mineral residual oil with Portland cement paste to form an admixture [2] almost perfectly nonabsorbent of water and therefore an excellent material to use in damp-proof construction, as flooring, etc. Where the various patent or noiseless floorings are used on the ground floor, they should always be laid over a concrete base, especially if they contain wood fiber as a constituent.

Bungalows or frame buildings in the country which have no cellar should be raised from the ground on stone foundations to a height which will allow light and air to penetrate beneath.

Where stone or concrete foundations are impracticable, timber impregnated with coal-tar creosote should be used. Untreated beams should never be laid on the earth nor imbedded in moist concrete, since they will rot, even if they do not become infested.

Beams in no case should be completely surrounded with mortar or brick; there should be an air space around the beams so as to permit air circulation. Beams should not be set *in* earth or *in* moist concrete but should be set *on* rock or dry concrete.

The supports of the woodwork of coal bins in basements or cellars should not be set in the ground but should rest on concrete. Window sills and frames in the basement or cellar should be laid over concrete, and the woodwork should not come in contact with the ground. There should be no untreated wood in contact with the ground through which white ants can come up from subterranean galleries. Complete dryness of foundation timbers and basement walls and flooring is an important means of rendering buildings safe from attack by white ants. Good subventilation should be secured; that is, a deep air space should be left between the ground and wooden flooring. If the flooring is to be of concrete, the concrete should be laid on a gravel base to prevent dampness. The supports of porches or steps should never be laid directly on the ground but should rest on rock or concrete.

In case of the plank platforms in front of suburban railroad stations, even if the planking be laid on the proper foundations the boards should not be joined closely together, but at least a ¼-inch space should be left between to allow light and air to penetrate and to prevent dampness and infestation by white ants. Often these platforms are roofed over and the wooden pillars supporting the roof are sometimes raised slightly off from the planking on iron rests. This prevents dampness, decay, and attack by white ants at the base (fig. 12). In other cases these pillars are set on a concrete base to one side of the planking, where they are not affected if the wooden boards of the platform decay.

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[1] The use of concrete on the farm. U. S. Dept. Agr. Farmers' Bul. 461, 23 p., 10 fig. 1915.
Concrete construction on the live-stock farm. U. S. Dept. Agr. Farmers' Bul. 481, 32 p., 24 fig. 1915.

[2] Page, L. W. Oil-mixed Portland cement concrete. U. S. Dept. Agr. Bul. 230, 26 p., 6 pl., 5 fig. 1916.

In the construction of greenhouses, iron frames and concrete work should be used in place of woodwork wherever possible, as this woodwork is often seriously injured by termites owing to the warm moist atmosphere maintained throughout the year. The wooden uprights supporting the wooden plant benches should never be set on or in the ground but should rest on stone, bricks, or concrete above the surface of the ground. Where woodwork is necessary, wood impregnated with a 1 per cent solution of bichlorid of mercury should be employed.

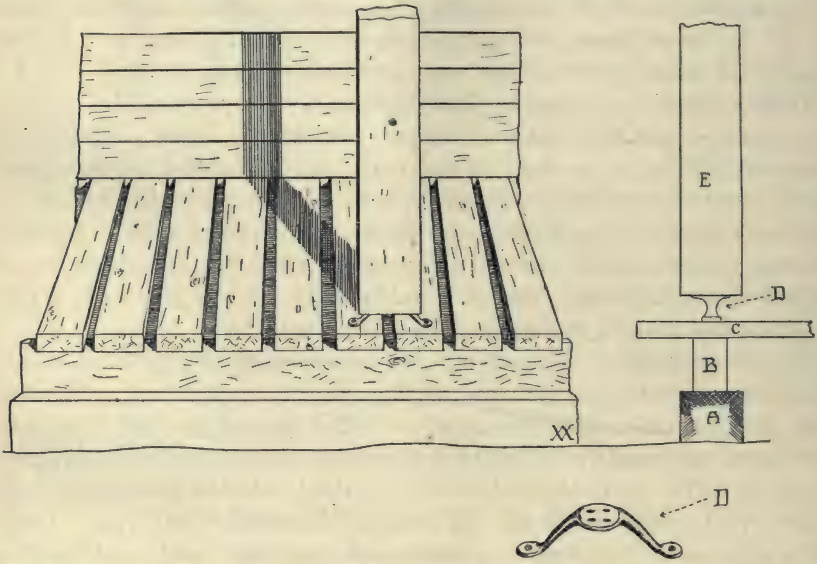

FIG. 12.—Properly laid platform planking and foundations for pillars, Falls Church, Va.: *A*, concrete base; *B*, stringer; *C*, planking; *D*, iron rest; *E*, pillar. (Original.)

All decaying wood in the vicinity of buildings should be removed and the breeding places of the insects destroyed.

Buildings on recently cleared woodland, unless the foregoing precautions are heeded, are especially liable to attack by white ants because of the presence of decaying wood and humus in the soil.

REMEDIAL MEASURES.

LOCATION OF DAMAGE.

As has been stated, it may be difficult to eliminate and stop further damage by white ants when once these insects have become established in the woodwork of a building. The approximate point of entrance should be sought at once by careful examination of all woodwork in contact with the ground. The foundation timbers, such as beams and joists in contact with the ground, and other woodwork in the basement or cellar should be examined so that the point of entrance of the insects and the extent of the damage already accomplished may be determined. It may be necessary to tear up the flooring and other woodwork to do this. The foundation timbers and interior woodwork found damaged should be removed, and the ground where they were set drenched with kerosene oil.

The annual emergence of large numbers of the flying white ants is an indication that the woodwork is infested, and the point of emergence indicates the approximate location of the infested timbers. Even if the insects are not observed swarming, large numbers of the dead winged adults or the discarded wings usually will be found near by. Frass and earth thrown out of crevices through which the insects emerge are also evidences of their presence. Sometimes the insects plaster the surface of wood with earthwork which will disclose their presence.

When efforts are made to stop further damage by termites in buildings, it should be realized that their numbers may be constantly recruited from some undiscovered, outside, central colony. The destruction of the winged colonizing adults at the time of emergence, while beneficial in preventing the establishment of potential new colonies, will not eradicate the insects infesting the woodwork.

Another warning of the presence of termite infestation is branching shelter tubes of small diameter, constructed of earth mixed with finely comminuted wood, on foundation timbers or other woodwork (fig. 13), or over the surface of stone, brick, or other impenetrable foundation material (fig. 14) from the ground to the woodwork. Drenching the ground where these tubes originate with kerosene oil will afford relief.

SUBSTITUTION OF STONE FOUNDATIONS AND TREATED TIMBER.

It is very rarely possible to find and destroy the external colony. The main purpose therefore must be to prevent the insects from gaining further access to the woodwork from colonies in the ground. This may be accomplished by replacing untreated foundation timbers and other woodwork in the basement or cellar with stone or concrete, including stone columns or pillars to support the flooring above, concrete or tile flooring, and concrete walls and partitions in the basement or cellar. If it is not practicable to substitute stone foundations, foundation timbers in contact with the ground should be replaced with timbers impregnated with coal-tar creosote.

Since the insects may have entered the building from their subterranean galleries by means of the supports of porchings and steps set in or on the ground, these last should be removed and the ground soaked with kerosene oil.

In some cases thorough and repeated drenching of infested timbers, where accessible, with kerosene oil may afford temporary relief and kill many of the white ants. Kerosene oil should be poured into the crevices through which the winged insects emerge and on the ground where the earthlike shelter tubes originate. Very rarely, however, is any permanent relief effected by these means alone.

In greenhouses iron frames and concrete work should, wherever possible, replace woodwork. The wooden uprights supporting the wooden plant benches should be sawed off, if set on or in the ground, and rested on stone, bricks, or concrete above the surface of the ground. Where woodwork is necessary, wood that is impregnated with a 1 per cent solution of bichlorid of mercury should be substituted. Wood impregnated with this preservative can be painted after treatment.

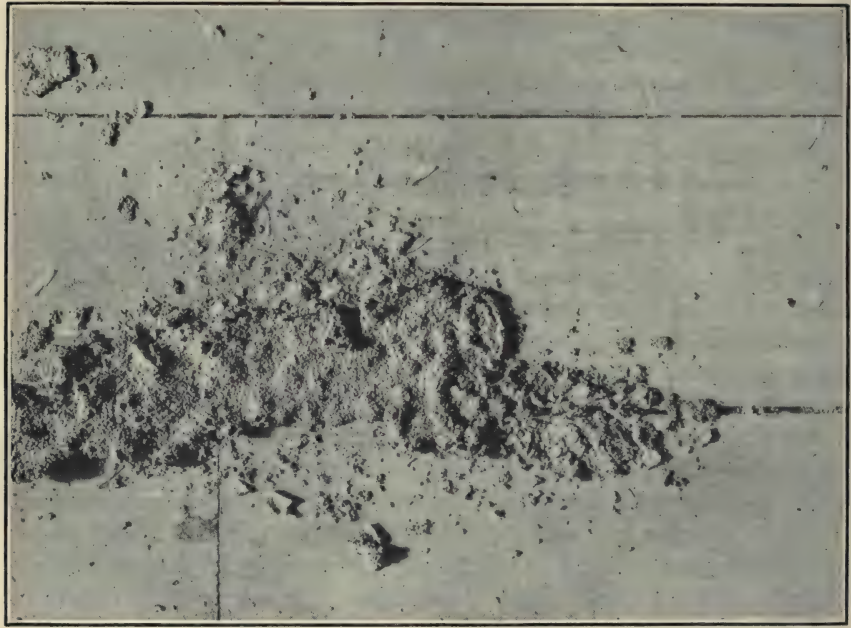

FIG. 13.—Earthlike shelter of the white ant *Leucotermes flavipes*, built on pine flooring in heated, damp, dark basement. The worker termites have come up through cracks between boards of the infested floor and made craterlike openings for the emergence of the winged, sexed adults. Note the shed wings on the floor. The swarm occurred February 14, 1916, in an old building in Washington, D. C. (Original.)

Poles, posts, construction timber, and other wood in contact with the ground should be treated with chemical preservatives to render the wood more resistant to attack by termites. Of the more superficial methods of preserving timber, brush or dipping treatments with coal-tar creosotes and carbolineums have proved to be the most effective. The most permanent known practical method is to impregnate the wood under pressure with coal-tar creosotes. Where it is impracticable to treat such timbers, as poles, posts, etc., to be set in contact with the ground, they should be selected from woods noted for durability and resistance to attack by white ants.

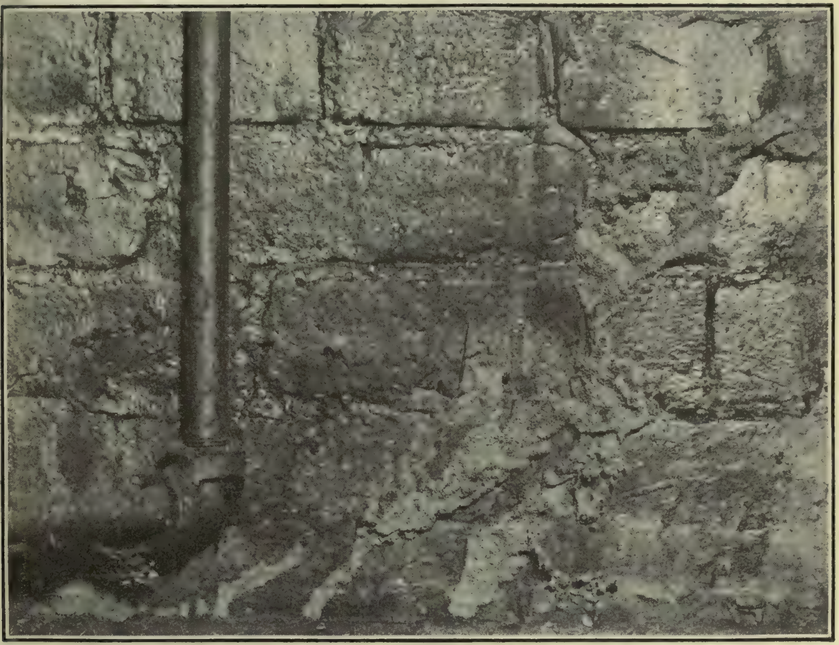

FIG. 14.—Earthlike shelter tubes of the white ant *Leucotermes flavipes*, constructed of earth mixed with finely digested, excreted wood, and built over brick wall in heated, dark, damp basement. These tubes extend through cracks between the basement pine flooring and the wall near a steam radiator. Note the granular structure. The insects use these tubes in passing over impenetrable substances and to protect them from the light in extending their galleries—in this case up to the next floor in an old building in Washington, D. C. (Original.)

PROTECTION OF STORED MATERIAL.

Injury to books, paper, documents, and other stored material or products is usually indirect, the insects as a rule burrowing through such material only where it is in contact with infested wood. Hence, if the insects are kept out of wooden structures, by the means already described, such damage can be prevented. Books, valuable documents, etc., should not be packed away in warm, unventilated chambers where they may become moist and moldy, and, therefore, particularly subject to attack by white ants. It should be borne in mind that termites are likely to be present in old buildings, even though their work has not been sufficient to attract attention. Once contact with the source of moisture (damp earth) is shut off, the insects infesting stored material soon leave, die out, or can be killed by spreading out infested books, documents, and other stored material or products to dry in the sun or in an oven, or outdoors during cold weather. Temperatures over 160° F. will kill the insects.

PROTECTION OF LIVING TREES.

Owing to the subterranean habits of white ants, it is extremely difficult to prevent or remedy injury to living forest, fruit, or shade trees. Care should be taken that the trees do not become scarred near the base, in order to prevent heartrot and subsequent infestation. Clean forest, orchard, and horticultural management is to be recommended. Properly executed tree surgery [1] sometimes may be effective in repairing damage to valuable old trees. Dead and dying infested trees should be removed and burned. Prunings should be burned promptly.

PROTECTION OF NURSERY STOCK, VINEYARDS, AND FIELD CROPS.

Injury to nursery stock will be most serious on recently cleared land where there is abundant decaying wood. Such débris, in which the insects breed, should be removed. In general, the use of recently cleared land should be avoided in planting nursery stock. Care should be taken not to allow the roots to dry out before planting; such weakened stock is liable to attack. In the case of the pecan, it is recommended that two or three cereal crops be grown on newly cleared land before the young trees are set out. The use of commercial fertilizers instead of stable manure is suggested. Deep late-fall plowing should be of value in breaking up subterranean nests. The practice of better farming methods, with rotation of crops, will prevent damage to field crops.

In vineyards, care should be taken in pruning operations; all dead or diseased vines should be removed. All pruned areas should be painted with coal tar, and the prunings should be burned promptly.

PROTECTION OF FLOWERS AND GREENHOUSE STOCK.

In flower or truck gardens, especially those located near the woodwork of buildings, less stable manure should be used in order to protect, not only the building, but also the growing plants.

The very volatile liquid carbon bisulphid can be used to kill white ants in the soil if moist and not compact, if small holes be made near the infested plants and a small quantity of carbon bisulphid poured in and the hole immediately closed tightly with earth. Care should be taken in handling this inflammable and explosive fluid, and the fumes should not be inhaled.

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[1] Collins, J. F. Practical tree surgery. *In* U. S. Dept. Agr. Yearbook for 1913, p. 163–190, pl. 16–22, 1914.

In the experiments conducted by Borden, in the Department of Agriculture at Washington, an effective control was found in the use of a 5 per cent kerosene-emulsion solution.[1] In case the benches can not be replaced immediately on account of a certain crop, it has been found practical to soak the ashes or sand under the pots and the infested benches thoroughly with this solution. This may be done by removing the potted plants from a section of the bench, spraying that section, and moving the pots on the bench up to cover the treated area, thus exposing another section to be treated. Potted heliotrope and geranium have been treated directly with the 5 per cent kerosene-emulsion solution without injury to the plants and the white ants in the soil of the pots were all killed. This treatment should be given late in the afternoon and followed early next morning with a thorough syringing with water to wash the surplus oil out of the soil. It is important also to remove all infested pots promptly from the bench as soon as they are noticed and to destroy the white ants with kerosene emulsion.

The removal of decayed infested woodwork in greenhouses will prevent the plants from becoming infested in turn.

SUMMARIZED RECOMMENDATIONS FOR PROTECTION OF WOODWORK IN BUILDINGS.

HOW BUILDINGS SHOULD BE CONSTRUCTED SO AS TO BE "WHITE-ANT PROOF."

Where possible, make the foundation of buildings entirely of stone, brick, or concrete, including stone columns or pillars in the basement to support the floor above; make the walls and flooring in the basement or cellar also of concrete, and lay concrete floors on a gravel base. Fill in and round off points of juncture between concrete walls and flooring so that these will not meet at right angles.

Where stone or concrete foundations are impracticable, use timber impregnated with coal-tar creosote.

Never completely surround beams with mortar or brick; leave an air space around the beams to permit air circulation. Set beams *on* stone or *on* concrete, not *in* the earth or *in* moist concrete. Rest the supports of porches or steps on stone or concrete.

Lay basement window sills and frames over concrete and do not allow the woodwork to come in contact with the ground. Never sink untreated timber in the ground or in moist concrete; let there b no wood in contact with the ground through which the termites may come up from subterranean galleries.

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[1] Kerosene emulsion formula:

Kerosene, 2 gallons.
Fish-oil soap, ½ pound.
Water, 1 gallon.

Method of preparation: Dissolve soap in hot water and pour in oil slowly while constantly stirring so as to emulsify.

Dilution: If 37 gallons of water be added to the above stock solution, it will give 40 gallons of 5 per cent kerosene emulsion.

Complete dryness of the foundation and basement walls and flooring is an important means of rendering buildings safe from attack therefore, provide for air spaces between the ground and woode flooring and lay concrete floors on a gravel base.

In greenhouses, replace woodwork, wherever possible, with iro frames and concrete work. Treat necessary woodwork, before use with a 1 per cent solution of bichlorid of mercury.

HOW TO ELIMINATE WHITE ANTS ALREADY ESTABLISHED IN BUILDINGS.

Promptly examine the foundation timbers and other woodwork i the basement to determine the approximate point of entrance and th extent of damage already accomplished. After removing th damaged wood, drench the ground with kerosene oil.

Break up the earthlike shelter tubes by means of which whit ants are sometimes able to pass over the surface of impenetrable substances in order to reach woodwork, and drench the ground beneat with kerosene oil.

Then replace damaged timber with rock, brick, or concrete; or, i this be impracticable, substitute, for the foundation, timbers treate with coal-tar creosote.

Since termites always require access to damp earth, shut off thi source of moisture, and the insects will not be able to extend th galleries farther and will perish.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 760 OCTOBER 16, 1916

Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.

HOW TO ATTRACT BIRDS IN NORTHWESTERN UNITED STATES.

By W. L. McATEE, *Assistant Biologist.*

CONTENTS.

	Page.
Introduction	1
Protection	2
Breeding places	2
Water supply	3
Food	4
Artificial supply	4
Food—Continued.	
Natural supply	6
Feeding seed-eating birds	6
Feeding fruit-eating birds	8
Protecting cultivated fruit	11

INTRODUCTION.

The means of increasing the number of birds about our homes are few and simple. They comprise adequate protection and the provision of suitable nesting places, food, and water. In a series of publications, of which this bulletin relating to northwestern United States (fig. 1) is the second,[1] it is planned to recommend practicable methods of attracting birds about homes in the various parts of the United States. Especial attention will be given to the value of fruit-bearing shrubs and trees, as less information relating to these as a means of attracting birds is available than concerning

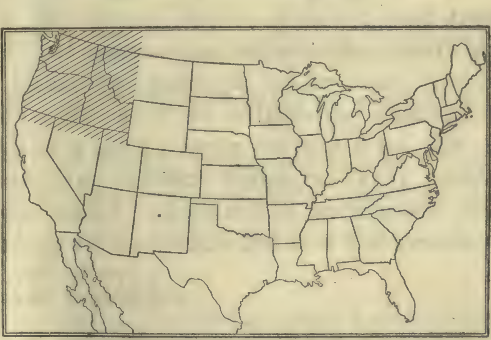

FIG. 1.—Map of the United States, the shaded area showing the territory to which this bulletin applies.

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[1] The first in the series was Farmers' Bulletin 621; McAtee, W. L., "How to Attract Birds in Northeastern United States," 15 pp., 11 figs., 2 charts, 1915.

NOTE.—Means of providing a food supply for wild birds about homesteads in the Northwestern States are especially described in this bulletin.

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more widely known but not more important measures, as protection, winter feeding, and the supplying of nesting boxes and water. Furthermore, the last-named measures need not vary so much with the locality as does choice of fruit-bearing shrubs and trees.

PROTECTION.

Protection is the prime requisite for increasing the number of birds in any area, and the results of protection are in direct proportion to its effectiveness. Besides being insured against every form of persecution by human kind, birds must be defended from various natural foes. The most effectual single step is to surround the proposed bird sanctuary with a vermin-proof fence (fig. 2). Such a fence should prevent entrance either by digging or by climbing, but will serve its greatest use if it can not be climbed and is therefore cat-proof. If it is impracticable to build an impenetrable fence, the next best device is to put guards (fig. 3) of sheet metal on all nesting trees and on poles supporting bird houses. This should be done in any case where squirrels or snakes are likely to intrude, as it is usually impossible to fence out these animals. Tree guards should be 6 feet or more above ground. Attacks by hawks, owls, crows, jays, or other enemies are best controlled by eliminating the destructive individuals. Those who wish to combat English sparrows will find full directions for so doing in Farmers' Bulletin 493.[1]

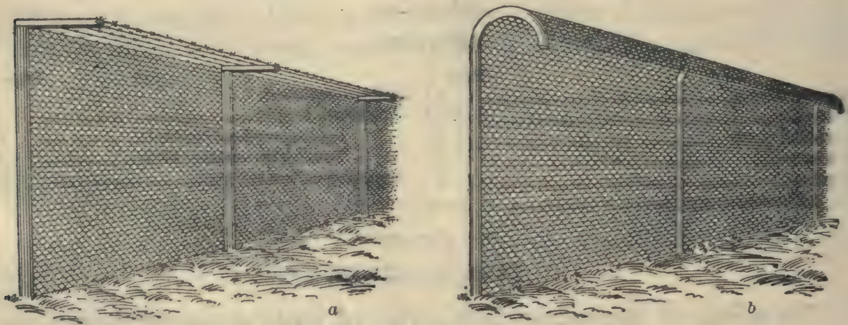

FIG. 2.—Cat-proof fence; *a*, with barbed wires; *b*, with loose overhanging netting.

BREEDING PLACES.

Although a considerable number of our native birds build their nests on the ground, the majority place them in trees or shrubs, either in holes or on the limbs or in the crotches. Shrubbery and trees for nesting sites, therefore, are essential for making a place attractive to birds, and a double purpose is served if the kinds planted are chosen from the list of fruit-bearing species given further on. Shrubs should be allowed to form thickets and should be pruned back severely when young so as to produce numerous crotches.

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[1] Dearborn, Ned, "The English Sparrow as a Pest," 24 pp., 17 figs., 1912.

Constant removal of old trees, and modern tree-surgery, have resulted in a great diminution in the number of tree cavities, the natural homes of most of our hole-nesting birds. Fortunately most of these birds will utilize artificial nest cavities, or bird houses. The sizes useful for various birds, plans for making, and illustrations of numerous bird boxes are given in Farmers' Bulletin 609.[1] The most common errors in putting out bird houses are choosing poor locations and supplying too many boxes. A bird house needs only partial shade, and houses on poles usually are taken. Martins prefer a house standing apart from trees. Entrances to boxes should be sheltered by projecting roofs and should face away from the prevailing wind and rain storms. All bird houses should be constructed so that the interior may easily be examined and cleaned.

As a rule birds do not like being crowded, and if a place is studded with bird houses only a few will be occupied. Birds not only do not want bird neighbors too near, but are impatient of human meddling, and therefore should be granted as much privacy as possible during the actual incubating and brooding. Nests built in shrubbery are especially likely to come to a bad end if the birds are frequently disturbed.

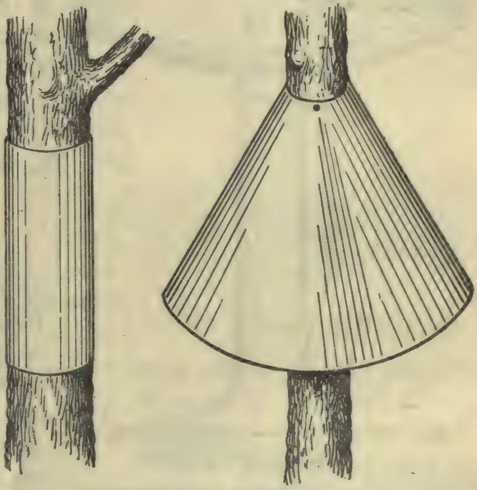

FIG. 3.—Tree guards.

If ground-nesting birds, as bobolinks, meadowlarks, and bobwhites, are to be protected, grass in the nesting fields must not be cut during the breeding season.

WATER SUPPLY.

Nothing has a more potent attraction for birds during hot weather than drinking and bathing places. The birds' water supply should be a pool not more than a few inches deep, the bottom sloping gradually upward toward the edge. Both bottom and edge should be rough, so as to afford a safe footing. A giant pottery saucer (fig. 4, *a*) is an excellent device, or the pool may be made of concrete, or even metal, if the surface be roughened (fig. 4, *b*). The bird bath may be elevated, or on the ground if on an open space where skulking enemies can not approach too near.

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[1] Dearborn, Ned, "Bird Houses and How to Build Them," 19 pp., 48 figs., 1914.

A water supply is appreciated in winter as well as in summer; if running water can not be provided that supplied should be warmed to delay freezing.

FOOD.

Food supply is the vital factor in bird life and the most important single offering that can be made in efforts to attract birds. It is important to note that an ample supply of food prior to and during the nesting season tends to increase the number of eggs laid and also the number of broods in a season. Bird food may be supplied in two ways—by planting trees, shrubs, and herbs which produce seeds or fruits relished by birds, and by exposing food in artificial devices. The most familiar phase of the latter method is winter feeding.

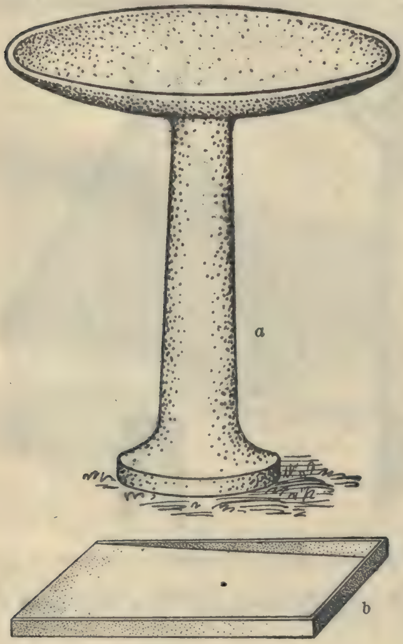

FIG. 4.—Bird baths: *a*, Pottery; *b*, metal or concrete.

ARTIFICIAL FOOD SUPPLY.

During the season when the natural food supply is at its lowest ebb birds respond most readily to our hospitality. Winter feeding has become very popular, and the result has been to bring about better understanding between birds and human kind.

The winter foods commonly used include suet or other fat, pork rinds, bones with shreds of meat, cooked meats, meal worms, cut-up apples, birdseed, buckwheat, crackers, crumbs, coconut meat, cracked corn, broken dog-biscuits or other bread, hemp seed, millet, nut meats of all kinds (especially peanuts), whole or rolled oats, peppers, popcorn, pumpkin or squash seeds, raw or boiled rice, sunflower seeds, and wheat.

The methods of making these supplies available to birds are as varied as the dietary itself. A device very commonly used is the food tray or shelf (figs. 5 and 6). This may be put on a tree or pole by a window or at some other point about a building, or strung upon a wire or other support on which it may be run back and forth. The last device is useful in accustoming birds to feed nearer and nearer a comfortable observation point. A fault with food shelves is that wind and rain may sweep them clean and snow may cover the food. These defects may be obviated in part by adding a raised ledge about the margin or by placing the shelf in the shelter of a wall or shielding it with evergreen branches on one or more sides.

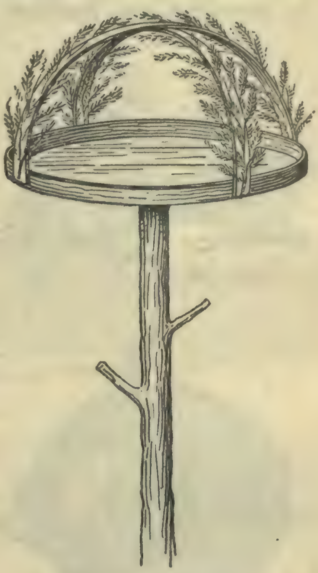
FIG. 5.—Food tray.

Feeding devices not affected by the weather are preferable. An excellent one is a coconut with a hole bored in one end (fig. 7). The cavity is filled with chopped suet and nuts or other food mixture, and the nut is suspended by a wire from a limb. The size of the hole regulates the character of the guests; if small, large birds can not gobble the supply. The coconut meat as well as the stuffing is eaten. Cans with small openings may be substituted for coconuts. Food baskets of any desired size made of wire netting or a metal grating may be hung up or fastened to the trunk of a tree. Food mixtures in melted fat may be poured into holes made in a branch or stick (fig. 8) or in cracks of bark or over evergreen branches. All of these devices minimize or obviate the disturbing effects of stormy weather.

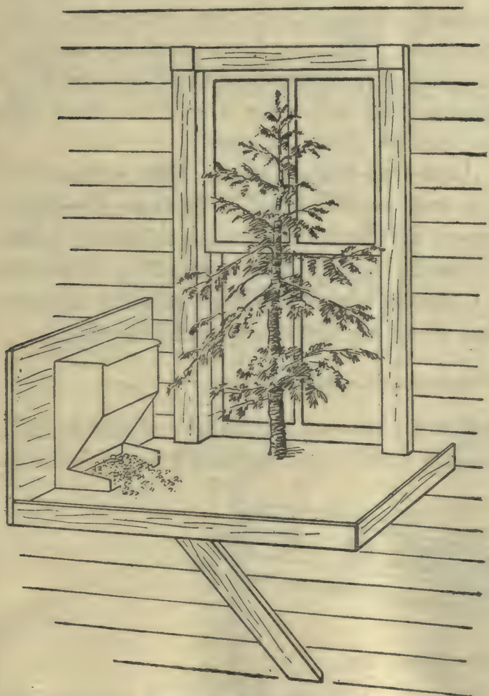
FIG. 6.—Food shelf.

More elaborate apparatus for the same purpose comprises various forms of food hoppers and food houses. The food hoppers (figs. 6 and 9) in common use for domestic fowls are adapted to the feeding of birds, and some special forms are now manufactured for wild birds.

The food house is a permanent structure, with solid roof, and glass on one or more sides to permit observations (fig. 10). The food trays it contains are entirely sheltered from the weather. In one style this result is obtained by mounting the house on a pivot and furnishing it with vanes (fig. 11) which keep the open side always away from the wind.

Game birds and sparrows may be provided with feeding places by erecting low hutches or making wigwamlike shocks of corn or grain sheaves under which food may be scattered. The opening should be to the south.

Those who desire to have birds about their homes should not feel that their power to attract them is gone when winter is over. Winter feeding easily passes into summer feeding, and experience proves that some birds gladly avail themselves throughout the year of this easy mode of getting a living.

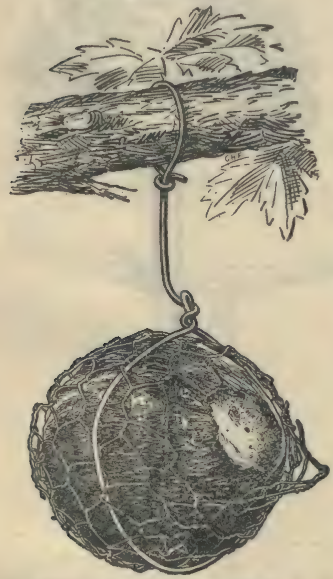

FIG. 7.—Coconut larder.

NATURAL FOOD SUPPLY.

We have thus far considered ways of feeding birds tidbits we ourselves have gleaned. We may feed them by another method, by cultivating their natural food plants and allowing them to reap the harvest in their own way.

Less has been done in this respect for the true seed-eating birds than for those fond of pulpy fruits. The reason is obvious—our seed-eating birds largely patronize weeds, which we do not wish to cultivate, while the fruit eaters depend upon many plants which are held in such esteem for their ornamental value that they are generally cultivated.

FEEDING SEED-EATING BIRDS.

Something can be done to attract the seed eaters about our homes, however. A number of commonly cultivated annual plants, belonging to the same groups as those upon which the birds feed extensively in nature, produce good crops of seeds. These plants, being dependent upon cultivation, can be used without fear that they will become pests. The following are suggested for the purpose: Prince's feather (*Amaranthus cruentus*), love lies bleeding (*A. caudatus*),

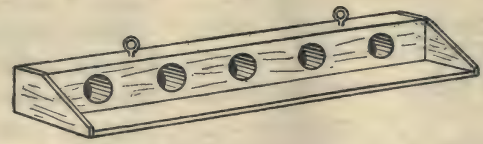

FIG. 8.—Feeding stick.

asters, calandrinias, blessed thistle (*Carduus benedictus*), centaureas, California poppies (*Eschscholtzia*), sunflowers, tarweed (*Madia elegans*), forget-me-nots, *Polygonum orientale* and *P sachalinense*, *Portulaca*, *Silene*, and sugar cane (sorghum varieties).

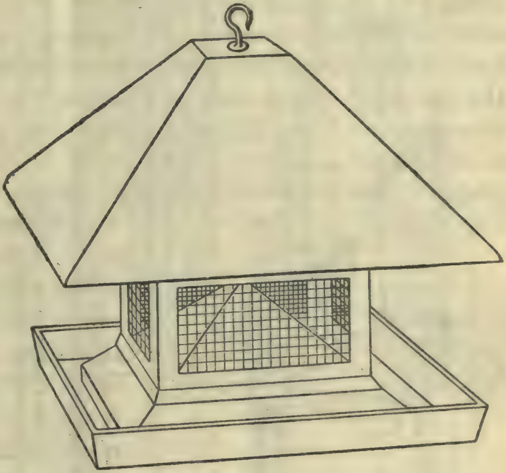
FIG. 9.—Food hopper (roof detachable).

The various millets are relished by nearly all seed-eating birds. Common millet (*Panicum miliaceum*), Japanese millet or barnyard grass (*Echinochloa crus-galli*), and German millet or Hungarian grass (*Setaria italica*) may be obtained from most seedsmen, and should be planted in abundance by those wishing to attract granivorous birds. The height and stiffness of stalk of varieties of sorghum should make these abundant seeders valuable in winter. Japanese millet holds its seeds well, and, if planted thickly where it can grow up though a horizontal lattice work, makes a valuable cover and feeding place for winter birds. Canary grass (*Phalaris canariensis*) and various species of *Pennisetum* also are good for seed-eating birds.

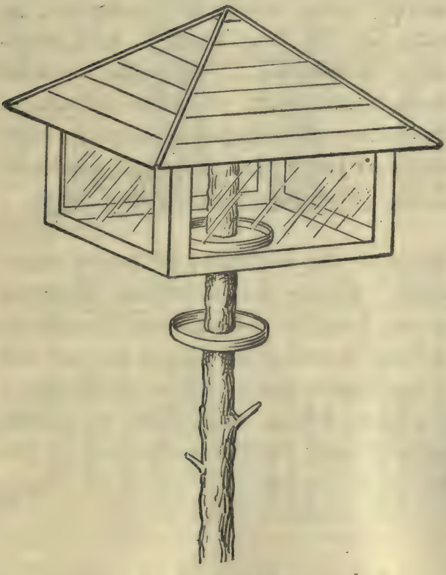
FIG. 10.—Food house.

Alders and birches bear in their numerous cones a supply of seeds which are eagerly sought for by redpolls, siskins, and goldfinches during the winter. Still another group of birds may be catered to by planting ashes and box elders. The winged fruits of these trees are opened and the seeds eaten by pine and evening grosbeaks, the visits of these birds being largely regulated by the supply of this kind of food. Larches, pines, and other conifers are attractive to crossbills as well as to some of the species just mentioned.

FEEDING FRUIT-EATING BIRDS.

Feeding fruit-eating birds is best accomplished by planting selected species of fruit-bearing shrubs and trees. Through late spring and summer there is usually an abundance of insect food in addition to fruit enough for all the birds. So far as fruit alone is concerned, fall is the season of overflowing abundance; in winter the supply gradually decreases, and late winter and early spring are the seasons of actual scarcity. This is the critical time of year for many birds, and a plentiful supply of wild fruit will tide them over. Fortunately, everywhere in the United States there are some fruits that persist until there is no longer any need of them. If enough are planted, no birds able to live on this class of food should starve. The best of these long persisting fruits are juniper, bayberry, thorn apples and related fruits, holly, and snowberry.

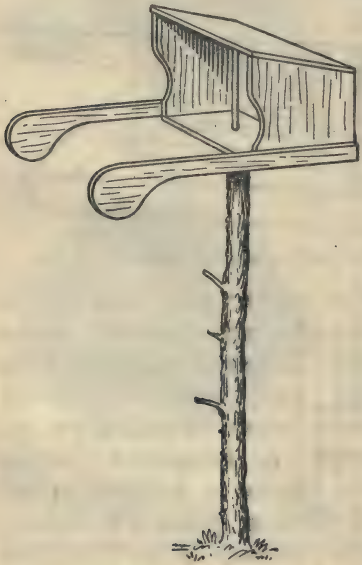

FIG. 11.—Food house on pivot.

The species listed in Table I are selected from a much larger number which are known to be favorites with fruit-eating birds. Various considerations have influenced choice, as ornamental value, earliness, lateness, or length of fruiting season, and especially availability of the plants through ordinary channels of trade. The data on fruiting seasons have been compiled from the principal herbaria of the Northwestern States, with a few additions from other sources.

The fruiting seasons indicated include the earliest and latest dates recorded for the Northwestern States. Hence it can not be expected that fruit will be available in any one locality throughout the entire bearing season of a plant unless a large number of plants are set out and in a variety of situations. Purchasers may obtain information from nursery catalogues as to where, when, and how to plant. Notes on species which may be substituted for some of those in the main list, and other comments, follow the table.

TABLE I.—*Seasons of fruit attractive to birds.*

Common name.	Scientific name.	Native or introduced.	Fruiting season.											
			Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Irish yew	*Taxus hibernica*	Introduced	■								■	■	■	■
Western juniper	*Juniperus occidentalis*	Native	■	■	■	■	■	■	■	■	■	■	■	■
Rocky M't'n juniper	*Juniperus scopulorum*	do	■	■	■	■	■	■	■	■	■	■	■	■
Bayberry [1]	*Myrica californica*	do	■	■	■	■	■	■	■	■	■	■	■	■
Hackberry [2]	*Celtis douglasii*	do	■						■	■	■	■	■	■
Russian mulberry [2]	*Morus alba* var. *tatarica*	Introduced						■	■	■				
Nandina	*Nandina domestica*	do	■								■	■	■	■
Barberry	*Berberis vulgaris*	do	■	■							■	■	■	■
Oregon grape	*Berberis nervosa*	Native	■	■	■				■	■	■	■	■	■
Currant [1]	*Ribes divaricatum*	do				■	■	■	■	■				
Currant [2]	*Ribes irriguum*	do					■	■	■	■				
Currant [1]	*Ribes sanguineum*	do					■	■	■	■	■			
Currant [2]	*Ribes aureum*	do	■			■	■	■	■	■	■	■	■	■
Salmon berry [1]	*Rubus spectabilis*	do					■	■	■	■	■	■		
Blackcap	*Rubus leucodermis*	do						■	■	■				
Evergreen blackb'y [1]	*Rubus laciniatus*	Introduced	■						■	■	■	■	■	■
Sweetbrier	*Rosa rubiginosa*	do	■	■	■	■	■	■	■	■	■	■	■	■
Rose	*Rosa gymnocarpa*	Native	■	■	■	■	■	■	■	■	■	■	■	■
Rose	*Rosa nutkana*	do	■	■	■	■	■	■	■	■	■	■	■	■
Rose	*Rosa pisocarpa*	do	■	■	■	■	■	■	■	■	■	■	■	■
Strawberry [1]	*Fragaria chiloensis*	do					■	■	■	■				
Strawberry [2]	*Fragaria platypetala*	do						■	■	■				
Serviceberry	*Amelanchier florida*	do				■	■	■	■	■	■			
Thornapple	*Cratægus douglasii*	do						■	■	■	■	■		
Firethorn	*Pyracantha coccinea*	Introduced	■	■								■	■	■
Firethorn	*Cotoneaster simonsi*	do	■									■	■	■
Crabapple [1]	*Pyrus diversifolia*	Native						■	■	■	■	■	■	
Mountain ash	*Pyrus sitchensis*	do						■	■	■	■	■	■	
Wild cherry	*Prunus emarginata*	do					■	■	■	■	■			
Choke cherry	*Prunus demissa*	do						■	■	■	■	■		

[1] West of Cascade Mountains.

[2] East of Cascade Mountains.

TABLE I.—*Seasons of fruit attractive to birds*—Continued.

Common name.	Scientific name.	Native or introduced.	Fruiting season.											
			Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Sumac [1]	*Rhus glabra*	Native	●	●	●	●	●	●	●	●	●	●	●	●
Holly	*Ilex aquifolium*	Introduced	●	●	●	●	●	●	●	●	●	●	●	●
Burning bush [2]	*Euonymus occidentalis*	Native							●	●	●	●		
Cascara	*Rhamnus purshiana*	do						●	●	●	●			
Virginia creeper	*Psedera quinquefolia*	Introduced	●								●	●	●	●
Japanese ivy	*Ampelopsis tricuspidata*	do	●								●	●	●	●
Buffalo berry	*Shepherdia canadensis*	Native						●	●	●				
Devil's club [2]	*Echinopanax horridum*	do							●	●	●	●		
Red osier	*Cornus stolonifera*	do	●					●	●	●	●	●	●	●
Dogwood [2]	*Cornus occidentalis*	do						●	●	●	●	●		
Dogwood [2]	*Cornus nuttallii*	do						●	●	●	●	●	●	
Bunchberry	*Cornus canadensis*	do					●	●	●	●	●	●		
Madrone [2]	*Arbutus menziesii*	do	●						●	●	●	●	●	●
Manzanita [2]	*Arctostaphylos tomentosa*	do					●	●	●	●	●	●	●	
Manzanita [2]	*Arctostaphylos manzanita*	do	●	●	●	●	●	●	●	●	●	●	●	●
Kinnikinnik	*Arctostaphylos uva-ursi*	do	●	●	●	●	●	●	●	●	●	●	●	●
Salal [2]	*Gaultheria shallon*	do							●	●	●	●	●	●
Blueberry [2]	*Vaccinium ovatum*	do							●	●	●	●	●	●
Blueberry	*Vaccinium cæspitosum*	do					●	●	●	●	●			
Red huckleberry	*Vaccinium parvifolium*	do					●	●	●	●	●	●	●	●
Cranberry	*Oxycoccus intermedius*	do	●	●	●	●			●	●	●	●	●	●
Snowberry	*Symphoricarpos racemosus*	do	●	●	●	●	●		●	●	●	●	●	●
Honeysuckle	*Lonicera ciliosa*	do						●	●	●	●			
Honeysuckle	*Lonicera involucrata*	do						●	●	●				
Honeysuckle	*Lonicera utahensis*	do					●	●	●	●				
Elderberry	*Sambucus glauca*	do							●	●	●	●	●	●
Elderberry [2]	*Sambucus callicarpa*	do						●	●	●	●	●	●	
Elderberry	*Sambucus racemosa*	Introduced	●					●	●	●	●	●	●	●
Highbush cranb'y	*Viburnum pauciflorum*	Native						●	●	●	●			
Black haw [2]	*Viburnum ellipticum*	do							●	●	●			

[1] East of Cascade Mountains.

[2] West of Cascade Mountains

Notes on the foregoing list.

Oregon grape. *Berberis aquifolium* (native) is just as good.

Currants. From the wealth of native species of currants *Ribes cognatum* and *R. viscosissimum* may be substituted in the arid interior, and *R. bracteosum* in the coast belt. *R. lacustre* and *R. cereum* are additional species of general range.

Serviceberry. Known for years as *Amelanchier alnifolia.*

Thornapple. Also known as *Cratægus brevispina.*

Crabapple. Also called *Pyrus* (or *Malus*) *rivularis.*

Mountain ash. Both the European and American mountain ashes (*Pyrus aucuparia* and *P. americana*) are known to hold their fruit to the middle of March at Pullman, Washington.

Dogwoods. *Cornus glabrata* also may be used west of the coast ranges. The bunchberry is native only to the higher altitudes, but can be cultivated generally.

Manzanita. *Arctostaphylos nevadensis* also may be used in the Cascade Mountains and westward.

Snowberry. *Symphoricarpos mollis* is as good as the species listed.

PROTECTING CULTIVATED FRUITS.

Birds devour cultivated fruit principally because the processes of cultivation diminish the wild supply. The presence of wild fruit in a locality always serves to protect domestic varieties, especially when the wild trees or shrubs are of the same kind as the cultivated ones and ripen earlier. Suitable kinds may be selected from those listed in Table I, for protecting various fruits according to the season of ripening. Among those most useful for the purpose are mulberry, wild blackberries and strawberries, serviceberry, wild cherry, and elderberry.

PUBLICATIONS OF U. S. DEPARTMENT OF AGRICULTURE RELATING TO BIRDS.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

Birds in Relation to the Alfalfa-Weevil. (Department Bulletin 107.)
English Sparrow as a Pest. (Farmers' Bulletin 493.)
Some Common Game, Aquatic, and Rapacious Birds in Relation to Man. (Farmers' Bulletin 497.)
How to Attract Birds in Northeastern United States. (Farmers' Bulletin 621.)
Common Birds Useful to the Farmer. (Farmers' Bulletin 630.)
Our Shorebirds and Their Future. (Separate 642 from Yearbook for 1914.)

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UNITED STATES DEPARTMENT OF AGRICULTURE

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MANAGEMENT OF MUCK-LAND FARMS IN NORTHERN INDIANA AND SOUTHERN MICHIGAN.

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CONTENTS.

	Page.
Introduction	1
Summary	2
Types of farming	3
Intensive and extensive crops	4
Development and management of muck land	21

INTRODUCTION.

In Indiana and Michigan there are approximately 3,750,000 acres of swamp land, largely muck. In northern Indiana and southern Michigan much of this land has been improved and is at present producing large quantities of grain, truck crops, and peppermint and spearmint oil. In many places the land has been farmed for from 10 to 25 years, and very definite types of farming have been developed. In fact, this section contains the largest area of improved muck land to be found in the North Central States. For this reason the investigations reported in the following pages were carried on in this region.

In this work the writer visited 140 muck-land farms. On 100 of these farms a detailed analysis of a year's business was obtained for the farm year beginning March 1, 1914, and ending March 1, 1915. This analysis consisted of a valuation of all farm property, including the amount of capital invested in land, buildings, live stock, machinery,

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NOTE.—This bulletin should be of interest to muck-land farmers of northern Indiana and southern Michigan and also to farmers in other sections of the country where soil and climatic conditions are similar or comparable.

supplies, and cash for current expenses, and an inquiry into the sources and amount of receipts, the nature and amount of expenses, the rate of depreciation on buildings and machinery, and other items bearing on the profits of the farm.

From practically all of the 140 farms information was obtained on the methods of draining muck land, results from the use of fertilizers and manure, cropping systems followed, and farm practices in general. The approximate location of the farms studied is shown in figure 1, black dots indicating farms studied in detail, circles indicating the locations of other farms visited.

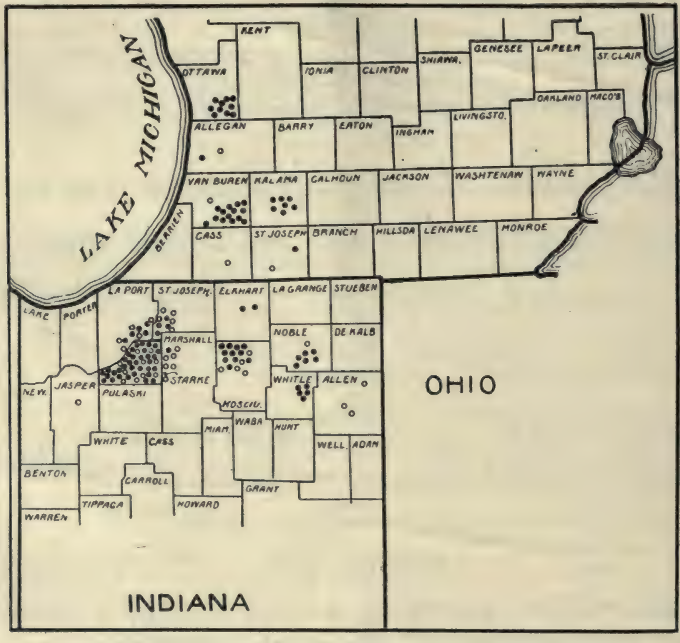

FIG. 1.—Map of area showing the approximate location of the farms studied.

The objects of this investigation were (1) to study the organization of muck-land farms in a representative area; (2) to determine the most reliable practices in the management of muck farms of different types; (3) to compare intensive and extensive farming on muck soil; (4) to determine the most profitable methods of utilizing unimproved muck land.

SUMMARY.

1. Four distinct types of farming are practiced on muck lands in northern Indiana and southern Michigan, viz, celery, onion, peppermint, and grain-and-stock farming.

2. The muck soil of this region is well suited to the growing of celery, onions, peppermint, cabbage, corn, and hay, and, when properly fertilized or manured, is fairly well adapted to oats, wheat, and rye.

3. *The use of fertilizer, especially potash, on muck soils is very profitable, the yields being increased in most cases from 50 to 200 per cent.* Manure also gives excellent results.

4. Celery and onions require an enormous amount of man labor as compared with corn, oats, and hay. Peppermint, cabbage, and potatoes occupy an intermediate position with regard to man labor.

5. *The gross acre value of intensive crops is high, but the value of these crops per day of man labor is not as high as in the case of extensive crops.*

6. The average labor income for 28 celery farms was $394; for 23 onion farms, $1,732; for 10 peppermint farms, $1,519; for 39 grain and stock farms, $1,056; and for 7 of the more successful grain-and-stock farms, $1,994

7. The expense for fertilizer and labor per crop acre is much greater on celery and onion farms than on peppermint and grain-and-stock farms.

8. Grain-and-stock farms provide a much better distribution of labor throughout the year than do celery, onion, or peppermint farms.

9. *Grain-and-stock farming is a much safer type of farming than any intensive type, although the profits per acre may be much less.*

10. *A small muck farm, even though operated intensively, will usually return only a moderate labor income.*

11. Tile drains were used on most of the muck farms studied. The best results have been obtained with 5 or 6 inch laterals laid 5 to 12 rods apart and at a depth of 3½ to 4 feet, although small open ditches are very satisfactory in some cases, especially on the celery farms.

12. The growing season on muck land is considerably shorter than on other land in the same region, on account of later frosts in the spring and earlier frosts in the fall.

13. Nearness to a market or shipping point is of great importance in the profitable production of truck crops.

TYPES OF FARMING.

Muck lands are adapted to many different crops, some of which form special industries of considerable magnitude. In the development of new areas of these lands, it is an important question whether to attempt this development along intensive or extensive lines, whether to grow the crops which produce large returns per acre or those which give large returns per man. Figure 2 shows a typical muck-land area developed along intensive lines.

The admirable adaptability of muck soils to highly intensive types of farming, such as truck growing and market gardening, has led to the popular belief that all muck soils should be farmed intensively. In this connection, however, a few facts are significant. In eight of the North Central States—Ohio, Indiana, Michigan, Illinois, Wisconsin, Minnesota, Iowa, and Missouri—there are 15,000,000 acres of swamp lands, which consist largely of muck soils capable of being drained and utilized for agricultural purposes. In the entire United States in 1909 there were approximately 125,000 acres of cabbage, 50,000 acres of onions, 15,000 acres of celery, and 8,000 acres of peppermint and spearmint, making a total for the five crops of only 198,000 acres, a large percentage of which, moreover, consists of areas other than muck. That the production of these crops is sufficient at present is evidenced by the frequent overproduction of one or more of them. Indeed it seems quite possible that all of the celery, onions, mint, and cabbage needed by the whole United States could be grown on 1 or 2 per cent of the muck land in the eight States mentioned above.

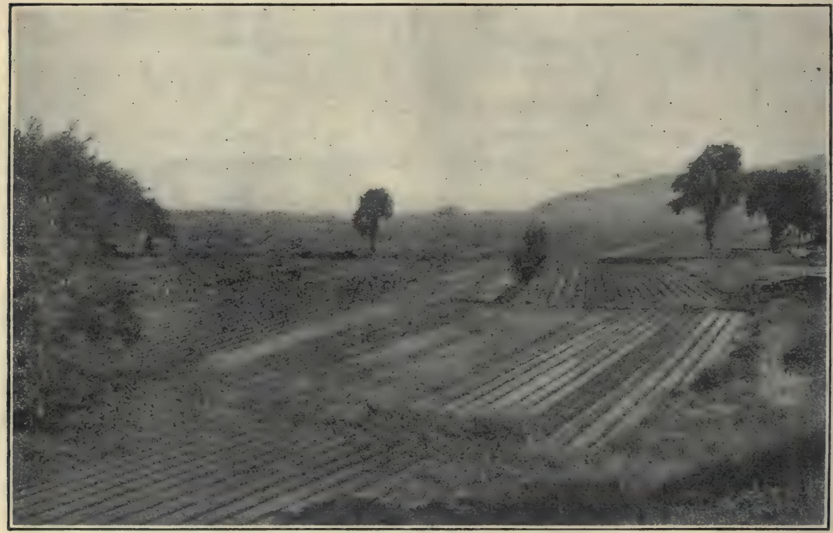

FIG. 2.—Muck land devoted to celery and other intensive crops.

INTENSIVE AND EXTENSIVE CROPS.

The most important and fundamental difference between intensive and extensive farming is the relative difference in the amount of labor required to farm a given area. This difference is not generally fully appreciated. As shown in figure 3, celery and onions require an enormous amount of man labor as compared with corn, oats, and hay. Cabbage, potatoes, and peppermint, with respect to labor, occupy an intermediate position between the highly intensive crops on the one hand and extensive crops on the other. Onions require less horse labor than celery, cabbage, and potatoes, because the cultivation of onions is all done with hand implements.

If the labor requirement and its distribution are known for a crop and also the time available for crop work during the year, it is possible to determine with a fair degree of accuracy the number of acres of crops or combination of crops that can be cared for by one man. Figure 4 shows the approximate number of acres of a number of the more important crops and one crop combination that can be cared for by one man. Here it is easily seen that one man can raise only a few acres of the more intensive crops without employing extra labor, but that he can handle a relatively large acreage of extensive crops, especially if these are combined in such a way as to give a fair distribution of labor.

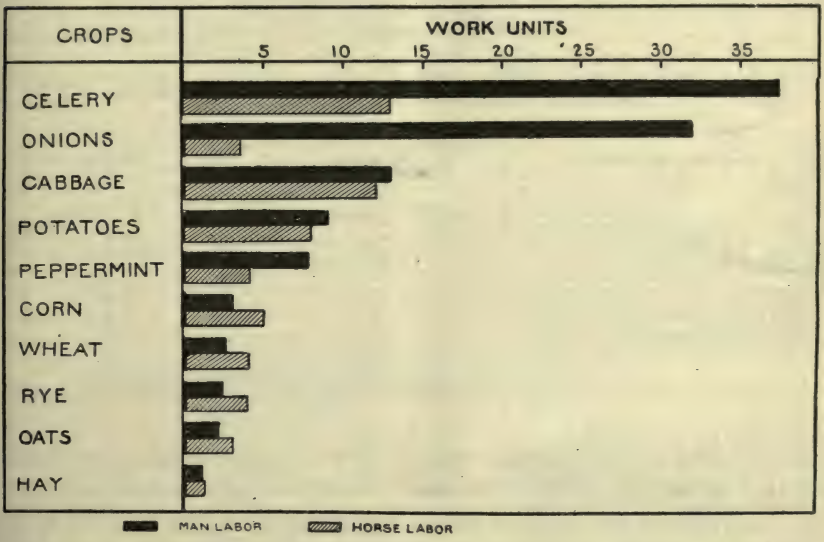

FIG. 3.—Days of man and horse labor required per acre by the more important crops grown on muck soil in northern Indiana and southern Michigan.

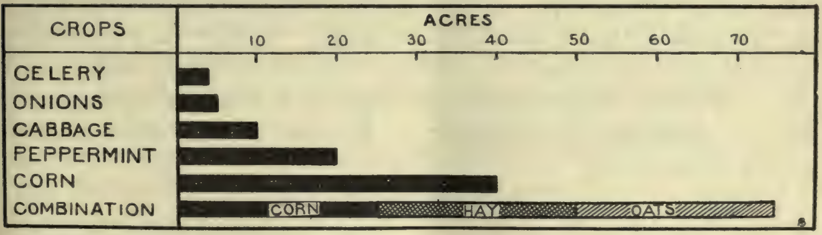

FIG. 4.—Approximate number of acres that can be worked by one man in different crops.

Another good comparison of intensive and extensive crops is shown in Table 1. The gross acre value of intensive crops is high, the average for five important crops being slightly over $100 per acre, but the average gross value produced by each day of man labor is only

$5.54, while for five important extensive crops the gross value of crops produced is $8.73 per day of man labor, but only $18.19 per acre.

TABLE 1.—*Gross value per acre, and per day of man labor.*

[Averages for 100 muck-land farms in northern Indiana and southern Michigan.[1]]

Crop.	Gross value produced.	
	Per acre.	Per day of man labor.
Corn	$30.08	$10.03
Hay	12.84	12.84
Onions	176.82	5.53
Oats	15.57	7.78
Potatoes	35.97	4.00
Wheat	19.28	7.71
Celery	161.52	4.31
Peppermint	64.70	8.09
Rye	13.20	5.28
Cabbage	69.30	5.77
Average for extensive crops[2]	18.19	8.73
Average for intensive crops[2]	101.66	5.54

[1] Figured on basis of average farm price and yield for 1914, and average labor requirements.

[2] Onions, potatoes, celery, peppermint, and cabbage are considered intensive and all the others extensive crops.

Even on muck soil, which is especially well suited to intensive farming, large profits on small farms are the exception, not the rule, although the small farmer can make a better living on muck soil than on types of soil not so well suited to intensive crops, especially if he has available family labor. As a rule farmers who have some capital and can afford to hire most of their labor will find intensive farming more profitable than will farmers who have to depend largely on their own labor. However, they must understand their business thoroughly and be able to handle men efficiently. On the other hand, men with relatively large farms, who must depend largely on their own labor or the labor of members of the family, will probably make better labor incomes if they raise extensive crops. It may be advisable to introduce into an extensive system of farming on muck soil a small acreage of some intensive crop to provide a better distribution of labor or profitable employment of children during their summer vacation from school.

FAVORABLE AND UNFAVORABLE CONDITIONS.

Many conditions, some favorable, others unfavorable, influence type of farming. The adaptation of crops to soil and climatic conditions; crop yields; the price of products; markets; cost of feed; availability, cost, and seasonal distribution of labor; the ravages of insects and of plant and animal diseases all have their influence in determining type of farmimg in any locality.

On muck lands frost is an important determining factor. The growing season on such soil is considerably shorter than on other soils in the same region. In northern Indiana and southern Michigan the earliest frost on these lands sometimes occurs as early as September 1 and the latest as late as June 10.

These conditions have been summarized for the more important muck-farm enterprises of this region in Table 2.

TABLE 2.—*Favorable and unfavorable conditions affecting types of farming on muck land in northern Indiana and southern Michigan.*

Farm enterprise.	Favorable conditions.	Unfavorable conditions.
Corn	Good yield and price, labor cost low	Danger of frost in spring and fall; weeds frequently troublesome.
Onions	High yield per acre and possibility of very large income per acre.	Fluctuations in price great; weeds hard to control; large amount of labor required; insect enemies.
Celery	Muck soil best for celery; large income per acre.	Large amount of labor required; danger of blight and rotting; price unstable.
Peppermint	Muck soil best for peppermint; possibility for very large income per acre with moderate amount of labor.	Demand very limited; fluctuation in price great; expensive equipment needed.
Potatoes	Easy to plant, cultivate, and harvest potatoes on muck.	Market discrimination against muck potatoes.
Hay	Yield good; price fair; labor cost very low.	Quality of muck hay sometimes poor due to rust.
Oats	Yield and price fair; labor cost low; good feed.	Danger of frost in spring and lodging at harvest time.
Wheat	Good yield; price stable; labor cost low.	Frequently heaves badly in winter, hard to get firm seed bed.
Rye	Good value as feed	Yield and price usually low.
Hemp	Good income per acre	Large amount of skilled labor required.
Cabbage	Possibility of good income per acre	Fluctuation in price; danger of rotting; large labor requirements.
Live stock	Good pasture and abundance of feed crops; value of manure.	High price of feed.

YIELDS AND PRICES FOR 1914.

Table 3 shows the average yield per acre, the disposition of crops, and the average prices received in 1914 as compared with the average prices[1] for the 10-year period 1905–1914.

There is a considerable difference between the average prices for 1914 and the 10-year average, but a little study shows that these differences just about counterbalance each other, so that considered as a whole, the farm receipts in 1914 were practically normal, although onion and peppermint farmers received somewhat less than normal prices for their principal products, while grain farmers received an abnormally high price for corn.

The yields of corn, wheat, and peppermint were slightly above the average in 1914, while other crop yields were almost normal.

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[1] Farm prices received for onions, celery, and peppermint were estimated from trade journal quotations; other figures are from reports of the Bureau of Crop Estimates, Department of Agriculture.

TABLE 3.—*Average yield, per cent sold, and price (1914 and 10-year average), for 11 principal crops grown on 100 muck-land farms, northern Indiana and southern Michigan.*

Crop.	Number of farmers growing.	Average yield per acre.	Per cent sold.	Average price received, 1914.	Average price, 1905–1914.
Corn .... bushels..	77	47.0	44.5	$0.64	$0.52
Hay .... tons..	68	1.2	26.7	10.70	11.90
Onions .... bushels..	50	421.0	100.0	.42	[1] .51
Oats .... do....	43	36.2	47.2	.43	.38
Potatoes .... do....	42	105.8	74.4	.34	.55
Wheat .... do....	39	23.8	91.0	.81	.91
Celery .... dozen..	32	1,346.0	100.0	.12	[1] .11
Peppermint oil .... pounds..	29	37.4	100.0	1.73	2.37
Rye .... bushels..	18	17.6	56.2	.75	.66
Hemp .... pounds..	3	1,170.0	100.0	.04	(2)
Cabbage .... tons..	2	15.0	100.0	4.62	(2)

[1] Average price, 1907–1915.
[2] No reliable data available

CELERY FARMING.

Figure 4 shows the average number of acres of each crop grown, the average amount of live stock kept, and the percentage of receipts from each farm enterprise on 28 celery farms in Michigan. Most celery farms are of from 5 to 10 acres and have a large proportion of this area in celery. A few farms are included in the average which, although they are distinctly celery farms, have considerable acreages of other crops. Hence the average of these 28 celery farms contained 15.2 acres of tillable land with 6.3 acres in celery. Most of the growers near Decatur, Mich., raise a few acres of peppermint, which is a very good practice. A few onions, grown on most of these farms, add to the diversity of the farm business and hence to the stability of the income.

The live stock kept on celery farms usually consists of a cow, a horse, and a few chickens. A few of the farms included in the average had several cows and two horses, which accounts for the cattle and horses shown in figure 5.

On these 28 celery farms, 76.3 per cent of the total farm receipts came from the sale of celery. Mint oil, dairy products, and onions made up 16 per cent and other much less important enterprises brought in the rest of the total farm receipts.

The celery of this region is grown chiefly in the vicinity of Kalamazoo, Decatur, and Hudsonville, Mich. Smaller acreages are grown in various other localities in Michigan, but very little is raised in Indiana. There are many other muck areas in both States in which celery could be grown successfully. Most of it is raised by Hollanders who settled in localities where conditions are particularly favorable to celery culture. Approximately 3,000 acres are raised annually in Michigan.

Most of the Michigan celery is shipped by express and placed on the market in a few days after it leaves the farm. A few growers ship it crated "in the rough." In this case it is packed in crates, shipped by freight, stored, and often kept for a considerable time. A large part of the Michigan celery goes to the Chicago market, but it is also shipped to many other points.

Much skill is required in the production of celery, and the wages paid for hired labor are proportionately high. Neither is it work which small children can do efficiently, but boys 16 years of age and over are frequently very skillful. Hence the celery grower raises, as a rule, only as many acres as he can handle himself, or with the help of his boys.

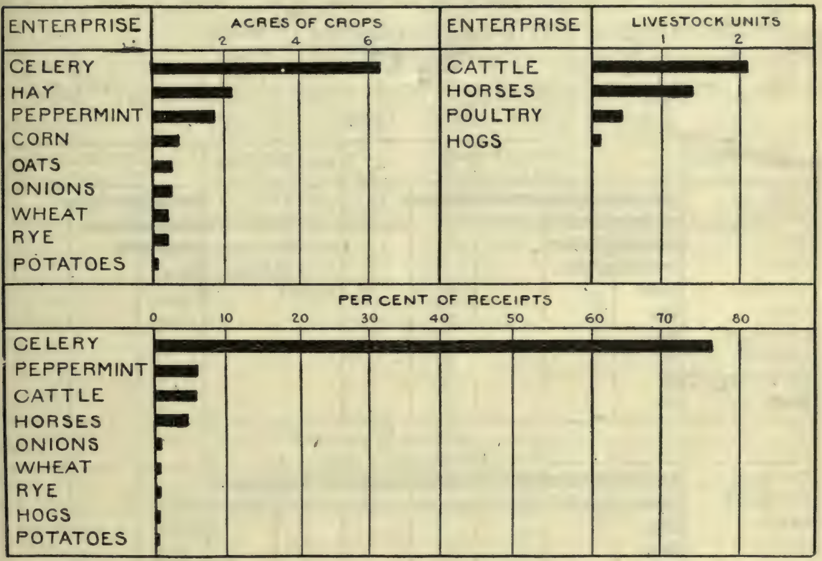

FIG. 5.—Number of acres of each crop grown, average number of livestock kept, and percentage of receipts from each farm enterprise on 28 celery farms in Michigan.

ONION FARMING.

Most onion farmers raise enough hay and corn to feed, but depend upon onions as the chief source of income. The 15.7 acres of onions raised on these farms occupied less than one-fourth of the total average crop area, but required a great deal more labor than all other farm enterprises. (See fig. 3.) Figure 6 shows the average number of acres of each crop grown, the number of live stock kept, and the sources and percentage of receipts on 23 onion farms in northern Indiana.

As a rule, celery is not grown as a side line on onion farms, although onions are frequently raised in small quantities on celery farms. In fact, many farmers on muck land raise some onions even though their principal income is derived from other sources. Children from 10 to 16 years of age, properly directed, can do the handwork on onions even more efficiently than men, and this work comes at a time when they are out of school. Many children from cities and towns, as well as from the farms, are thus given profitable employment in the onion fields during the summer.

A few men grow onions exclusively, but they usually have considerable capital and can withstand occasional heavy losses due to overproduction, the ravages of disease and insects, or destruction by floods or windstorms. Such a system of farming is not practicable except in localities where labor is plentiful during the summer months. Onions alone give a very poor distribution of labor.

The live stock kept on an average onion farm consists of a few cattle and hogs in addition to the work horses. Horse labor is employed in preparing the seed bed in the spring and in harvesting the crop in the fall. All cultivating and weeding must be done by hand, or with hand tools. Horse tools are not used in the cultivation of onions, hence they provide a much poorer distribution of horse labor than celery. It is largely for this reason that onions are grown in connection with other crops.

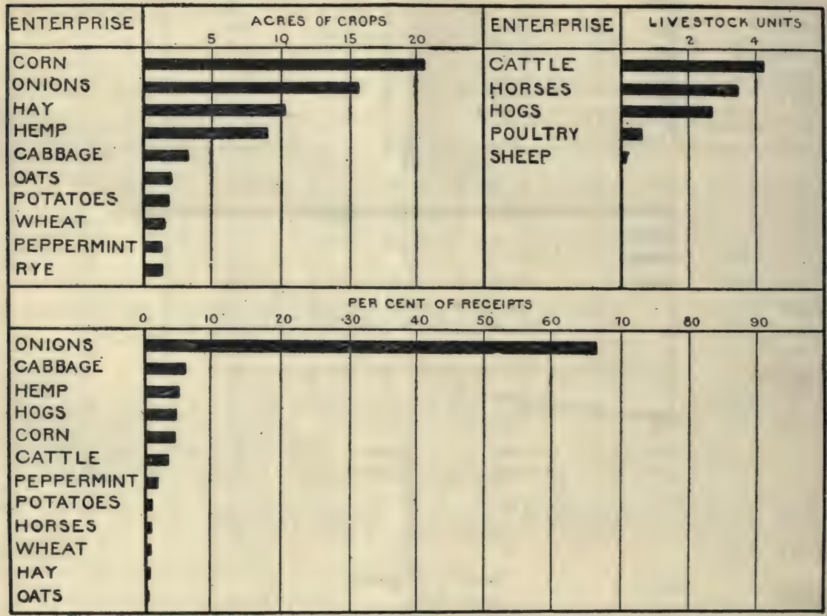

FIG. 6.—Number of acres of each crop grown, average number of livestock kept, and percentage of receipts from each farm enterprise on 23 onion farms in northern Indiana.

On the 23 onion farms studied, 66.3 per cent of the total farm receipts came from onions, all other receipts being derived from minor farm enterprises. Two farms sold a total of $4,697 worth of hemp, and one farm sold $5,700 worth of cabbage. Grain and live stock were sold in very limited amounts.

From 4,000 to 6,000 acres of onions are grown annually in northern Indiana, while only 1,000 to 1,500 acres are grown in Michigan. The acreage grown varies greatly from year to year.

Some of the large growers own storage houses and are able to hold their onions for the winter market, but most of them sell to commission men at harvest time. Onions produced in this region must be marketed about March 1 because Texas onions come on the market shortly after this date. (For full information on onion culture see Farmers' Bulletin No. 354.)

PEPPERMINT FARMING.

Peppermint was grown on 29 of the farms studied, but only 10 were distinctly peppermint farms. Like onion farmers, peppermint farmers usually raise enough grain and hay to feed, but very little to sell. These ten mint farmers raised an average of 35 acres of peppermint, 18.3 acres of corn, and 19.1 acres of hay. Most of the hay on these farms is made as a by-product from the peppermint after the volatile oil has been extracted by distillation. The refuse from the stills is scattered, dried, and made into hay. On large mint farms much of the refuse is returned to the fields as manure. (For further information on the growing of peppermint and spearmint see Farmers' Bulletin No. 694.) Figure 7 shows the average number of acres of each crop grown, the number of live stock kept, and the percentage of receipts from different sources on these 10 farms.

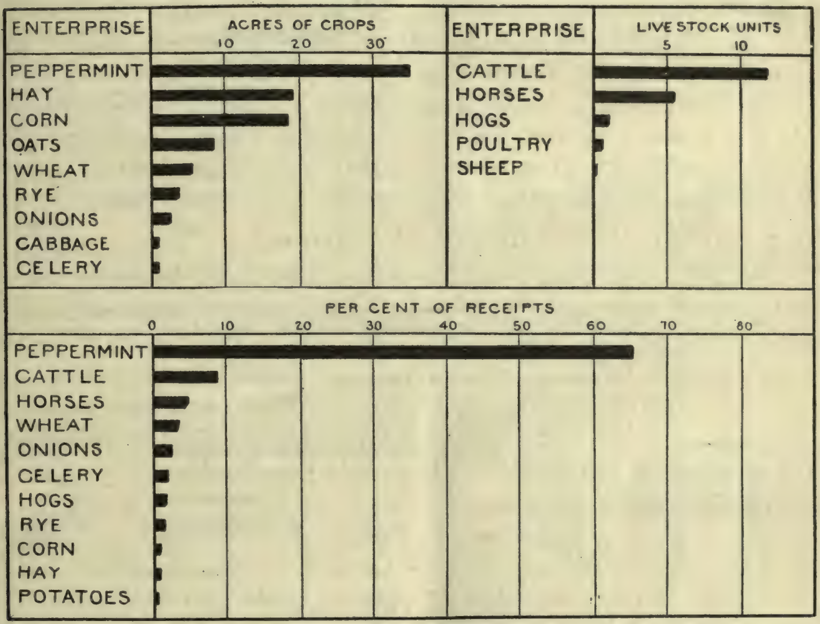

FIG. 7.—Number of acres of each crop grown, average number of livestock kept, and percentage of receipts from each farm enterprise on 10 peppermint farms in northern Indiana and southern Michigan.

Aside from work horses, cattle are about the only live stock kept on mint farms. Pasture is abundant in summer, and cows or steers can be wintered largely on mint hay.

The production of peppermint and spearmint is a highly specialized and also a highly localized industry. The oils are used entirely for medicinal and flavoring purposes, and the current demand is met by production practically confined to a few thousand acres of muck land in northern Indiana and southern Michigan. Any material increase in acreage results in a corresponding reduction in price, so that it may be assumed that the acreage devoted to these crops is about as large as the present market justifies. The acreage of spearmint is only a small part of the total area of both crops.

In the extraction of the essential oil from these plants, a somewhat expensive equipment is necessary. Hence the growers must either plant an acreage large enough to justify the installation of a still, or arrange to have the distilling done on a neighboring farm. Partnership equipment is common, and there are many farmers raising only a few acres of mint as a side line who have the service of a neighborhood still. Most of the peppermint and spearmint is grown by a few men who have had long experience in the business.

GRAIN-AND-STOCK FARMING.

Some grain was grown and some live stock kept on almost every farm studied, and 39 farms are classed as distinctly grain-and-stock farms. The principal crops were corn, oats, wheat, and hay, in the order named. Potatoes, rye, onions, and peppermint occupied only minor positions in the cropping system. Hemp was grown on one farm in this group. Figure 8 shows the average number of acres of each crop grown, the number of live stock kept, and the percentage of receipts from differ ent sources for these farms.

The live stock kept consisted of cattle, horses, and hogs. Cattle and hogs are both well adapted to the muck-land farms of this region on account of the abundance of pasture, grain and hay. Furthermore, cattle assist in compacting the soil.

Corn, hogs, wheat, and cattle, in the order named, were the principal sources of receipts. Most of the hay and a large part of the oats raised were fed to the live stock.

In the past attention has been given chiefly to the development of muck lands along the intensive lines, but it is now plainly evident that if large areas of these lands are to be utilized, extensive systems of farming must be developed. Hence a study of some of the more successful grain-and-stock farms will be especially valuable in this connection. In the above mentioned group of 39 farms seven were located on typical deep muck soil and grew almost exclusively corn, oats, wheat, and hay. These farms varied in size from 160 to 420 acres, the average being 281.1 acres, with 253 acres of tillable land,

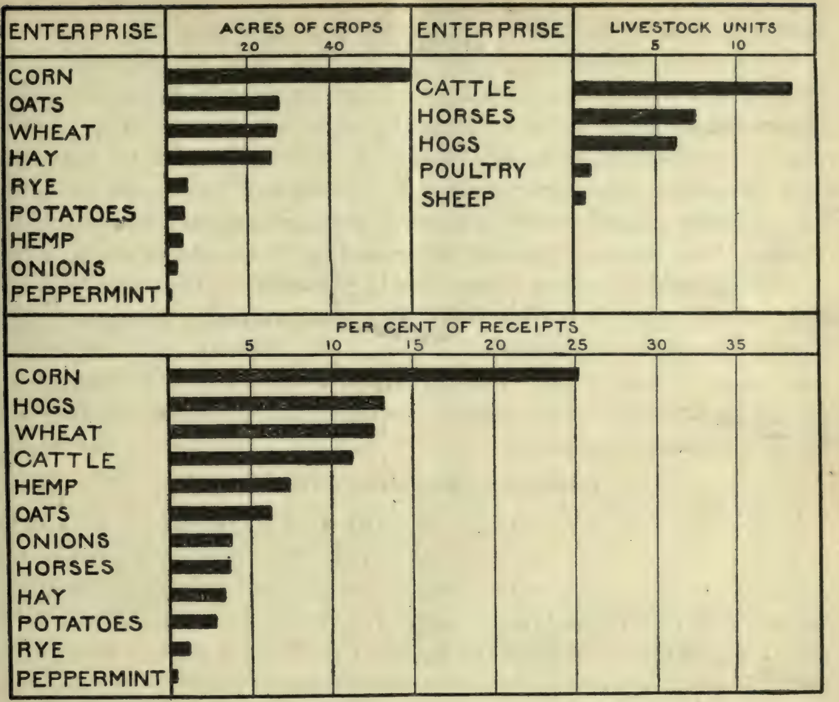

FIG. 8.—Number of acres of each crop grown, average number of livestock kept, and percentage of receipts from each farm enterprise on 39 grain-and-stock farms in northern Indiana and southern Michigan.

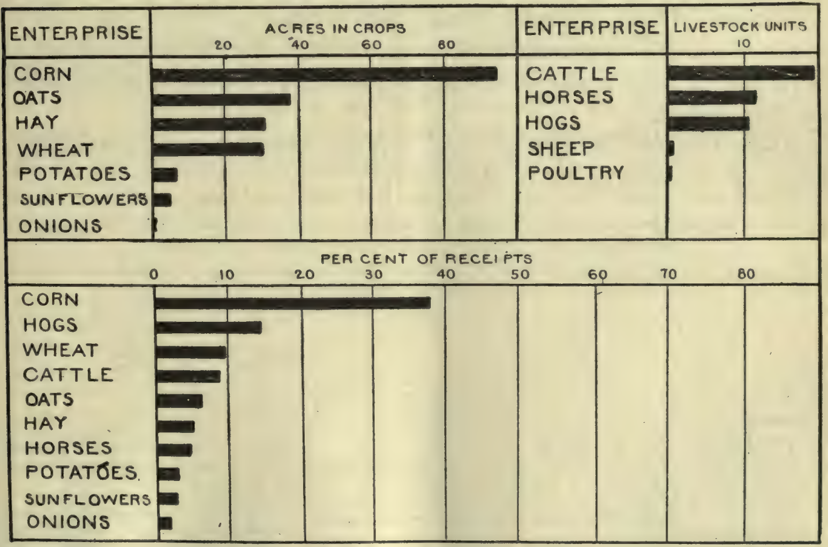

FIG. 9.—Number of acres of each crop grown, average number of livestock kept, and percentage of receipts from each farm enterprise on 7 successful grain-and-stock farms in northern Indiana.

Figure 9 shows the average crop acreage, number of live stock kept, and sources of receipts for these seven general farms.

The principal sources of receipts were corn, hogs, wheat, and cattle. Crop yields and quality of live stock on these farms were somewhat above the average, but not exceptional. The average yield of corn was 55 bushels, of oats 38, wheat 26, and hay 1.3 tons per acre. The owners of these farms spent an average of $179 each for fertilizer, mostly potash, which accounts in large measure for their good yields. Two of them sold no corn, feeding it all to live stock, while only three sold hay in any considerable quantity. One man sold 105 tons at $13 per ton, clear of baling and shipping charges. Hay requires less labor than any other crop, and yet yields well and usually commands a fair price. The acreage of muck land devoted to the growing of timothy hay should be materially increased in this and other muck-land regions.

INVESTMENT, RECEIPTS, AND PROFITS.

The difference between the receipts and expenses of a farm is called the "farm income." If he is free from debt, the farmer has this amount of money for defraying the living and personal expenses of himself and family, and for savings or investment. The farm income takes no account of the capital invested, and hence is not a measure of the efficiency of the farmer or of his farming system. If, however, the customary rate of interest on the capital invested is charged as a farm expense and deducted from the farm income, the remainder thus obtained represents the real earning power of the farmer under his conditions. This figure is called the "labor income," and, as the name implies, it represents the wages which the farmer receives for his labor and managing ability after making due allowance for interest on investment.

Table 4 shows the average size, capital, receipts, and profits for the types of farms included in this study.

TABLE 4.—*Relation of type of farming to receipts, investment, and labor income on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Type of farming.			
	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Averages per farm:				
Acres of land	19.2	104.0	148.6	235.0
Total capital	$5,630	$12,611	$16,410	$27,673
Receipts from onions	63	2,792	88	138
Receipts from celery	1,079	....	68	....
Receipts from peppermint	83	76	2,365	12
Receipts, grain and hay	9	215	223	1,810
Receipts from live stock	124	421	592	1,170
Receipts, other sources	56	709	218	427
Total receipts	1,414	4,213	3,554	3,751
Farm income	675	2,363	2,339	2,440
Labor income	394	1,732	1,519	1,056

The celery farmer, with an average of 19.2 acres, and an investment of $5,630, made a labor income of $394. Although this is not large, it is nevertheless a fair income, and equal to the incomes earned by farms of two or three times the size in many sections of the country. Twenty-three onion farms, with an average of 104 acres, and an average total investment of $12,611, made labor incomes averaging $1,732. The average onion farm, however, was more than five times as large as the average celery farm, and represented a total investment of more than twice as much capital. Ten peppermint farms, with an average of 148.6 acres, and an investment of $16,410, made labor incomes averaging $1,519, while thirty-nine grain-and-stock farms, with an average of 235 acres, and an investment of $27,673 earned labor incomes of $1,056.

The seven more successful grain-and-stock farms shown in figure 8 made labor incomes averaging $1,994. Their average size was 281 acres, and average investment $41,795.

The above labor incomes were made in 1914. These are not fixed quantities and will vary from year to year. Profit in onion, peppermint, and celery farming varies much more than in grain-and-stock farming because of greater variation in both yields and prices.

DISTRIBUTION OF EXPENSES.

The operating expenses run highest on celery and onion farms. The percentage of expense for labor is considerably higher on onion farms than on any other type. On celery farms the operator does most of the work himself, so that his actual expense for labor is low.

The expense for feed purchased is high on celery farms, since celery farmers raise very little feed. The expense for fertilizer is next to that for labor in importance, the average for all the farms being 9.9 per cent. The expense for seed is highest on onion farms. The percentage of receipts required for operating expenses and the percentage of the current expenses represented by the expenses for labor, feed, fertilizer, and seed on the various types of farms are shown in Table 5.

TABLE 5.—*Relation of type of farming to the distribution of current expenses on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Type of farming.			
	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Average total investment	$5,630	$12,611	$16,410	$27,673
Percentage of receipts required for operating expenses	46.9	40.5	28.1	30.5
Percentage of expenses for labor [1]	38.6	60.3	45.6	43.0
Percentage of expense for feed	17.0	4.6	1.7	5.1
Percentage of expense—fertilizer	10.5	9.9	13.9	8.7
Percentage of expense—seeds, etc	3.6	18.7	1.9	4.6
Percentage for other expenses	30.3	6.5	36.9	38.6
Total expenses	100.0	100.0	100.0	100.0

[1] Includes hired labor and allowance for unpaid family labor other than the operator's.

COST OF LABOR AND FERTILIZER.

The cost per crop acre of the two most important items of expense, viz, labor and fertilizer, for the different types of farms is shown in Table 6.

TABLE 6.—*Relation of type of farming to cost of fertilizer and labor per crop acre on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Type of farming.			
	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Cost of fertilizer per crop acre	$5.18	$2.36	$1.43	$0.62
Total cost of labor per crop acre	$50.00	$22.00	$9.00	$6.00

This table shows clearly the large amount of labor required by celery and onions. It should be borne in mind in comparing these labor costs that they are for all crops, and that the celery farm ordinarily has a larger percentage of the farm area in celery than the onion farm has in onions. Peppermint and grain-and-stock farming require relatively a small amount of labor. Almost the same relation exists between the fertilizer cost per crop acre and type of farming.

LABOR INCOME AND LABOR COST.

Table 7 shows, in addition to labor income, the total value of the labor required to operate the various types of farms, and the labor incomes of the operator per day. The total value of labor is the sum of the amount spent for hired labor, the value of the labor performed by members of the farm family, and the value of the farmer's own labor. The labor income per day is obtained by dividing the labor income by 300. This, however, is only of incidental interest.

TABLE 7.—*Relation of type of farming to total cost of labor and labor income on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Labor income	$394	$1,732	$1,519	$1,056
Total value of labor	$678	$1,559	$895	$1,034
Operator's labor income per day	$1.31	$5.78	$5.06	$3.52

NET RETURNS FOR PRODUCTIVE LABOR.

The number of crop acres per man is a good index of the degree of intensity of the different types. Celery growers do not grow much of anything else; onion and peppermint farmers, however, usually grow a considerable acreage of more extensive crops (see fig.6); while grain-and-stock farmers raise little but extensive crops. Celery requires a large amount of horse labor, while onions and peppermint require little more than extensive crops. The relation of type of farming to a number of the important factors of farm efficiency is shown in Table 8.

TABLE 8.—*Relation of type of farming to factors of efficiency on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Type of farming.			
	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Crop acres per man	7.5	21.0	40.6	73.0
Crop acres per horse	9.6	22.3	21.2	24.3
Productive work units per man	159.0	198.6	238.9	294.1
Productive work units per horse	76.9	104.4	82.6	97.0
Cost of man labor per productive work unit[1]	$2.37	$2.31	$1.56	$1.60
Labor income for each productive man work unit[2]	$1.38	$2.56	$2.65	$1.63
Value of productive work unit of operator[3]	$2.48	$8.72	$6.36	$3.58

[1] Obtained by dividing the total value of labor by the total productive man work units.
[2] Obtained by dividing the labor income by the total productive man work units.
[3] Obtained by dividing the labor income by the productive work units per man.

The number of productive work units[1] (or days' work) per man varies greatly on farms of different types for a number of reasons. Grain-and-stock farming furnishes the best distribution of labor throughout the year. In this group there were 294.1 productive work units per man or a day's work for each man employed for almost every work day in the year. On the peppermint farms there were only 238.9 units of productive work per man, owing to a less satisfactory distribution of labor. Onion and celery farms use labor still less efficiently. Celery farmers are also the least efficient users of horse labor. The cost of man labor for each productive work unit is highest on celery and on onion farms, and lowest on grain-and-stock farms. The labor income for each productive work unit of the operator is shown in the last line of Table 8.

INCOME PER WORKER EMPLOYED.

The labor income per man for the various types of farms studied in 1914 is shown in Table 9. This was obtained by dividing the average labor income plus the expense for labor by the average number of men employed on the farm, including the operator. The labor income per man is lowest on the average celery farm, which represents the most intensive type. On grain-and-stock farms the labor income per man is comparatively high, averaging almost as much as on onion and peppermint farms, and some years going even higher than on the specialized farms.

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[1] A work unit, as the term is used in this bulletin, is an average day's work for a man or a horse. A productive work unit is an average day's work at any farm enterprise which adds directly or indirectly to the gross income of the farm. Work done in the production of crops and caring for dairy cows, hogs, feeding steers or sheep, is productive labor, but time spent in repairing buildings, fences, or machinery and in caring for work horses is unproductive labor and is not included.

TABLE 9.—*Relation of type of farming to the labor income per worker on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Types of farming.			
	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Average number of workers	1.8	3.4	2.4	2.2
Labor income per worker	$361	$813	$823	$702

TOTAL AND WORKING CAPITAL AND VALUE OF REAL ESTATE PER ACRE.

The relation of type of farming to the area of tillable land, to the investment, value of real estate per acre, and miles to market is shown in Table 10.[1]

TABLE 10.—*Relation of type of farming to area of tillable land, total investment, working capital, and value of real estate per acre on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Type of farming.			
	Celery.	Onion.	Peppermint.	Grain-and-stock.
Number of farms	28	23	10	39
Average area of tillable land	15.2	84.4	119.4	195.6
Average capital	$5,630	$12,611	$16,410	$27,673
Average working capital	$713	$2,260	$2,610	3,234
Working capital per acre of tillable land	$47	$27	$22	$16
Value of real estate per acre	$378	$101	$109	$105
Average distance to market ... miles	1.1	3.1	2.8	3.7

It is evident that celery farms have the least working capital but the greatest amount of working capital per acre of tillable land. Thus intensive types of farming require more working capital per acre than is required by extensive types.

The value of real estate on onion, peppermint, and grain-and-stock farms is only slightly above $100 per acre, but in the case of the celery farms the value of the real estate rises to $378 per acre, partly owing to the greater proportionate value of the buildings and partly to the fact that celery farms are highly developed and very close to market.

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[1] Working capital is the sum of the investments in live stock, machinery and equipment, feed and supplies, and cash for current expenses.

RISK AND PROFIT.

In all types of farming there is an element of risk due most largely to fluctuations in prices of farm products and variations in yields of crops from year to year. In the more extensive and stable types of farming this element of risk is not large, though it is, nevertheless, an important factor; but in the more intensive types, such as truck and fruit growing, it is responsible alike for startling successes and for disastrous failures.

Farmers of course realize that their profits depend largely upon conditions over which they as individuals have little or no control and that all farming is accompanied by considerable risk. They also realize that the risk varies with different types of farming. For the country as a whole, and to a less extent for the principal producing centers, a low yield of a crop results in a correspondingly high price, and vice versa. The farm price of potatoes in Indiana is influenced very materially by the yield in Michigan and Wisconsin, because the latter States are great potato-producing centers and serve the same markets as Indiana. The price of onions in Ohio is influenced by the yield of onions in New York and Indiana for a similar reason, but the price of oats in Pennsylvania is determined largely by the yield of oats in the central west because the Pennsylvania crop is too small to affect the market, the price being determined by the supply in the great center of oat production. Thus, in any given locality, the fluctuation in prices from year to year has a much greater effect on farm profits than variations in yield. This is especially true of crops which are consumed in relatively small quantities, such as vegetables and fruits.

The risk involved in onion, celery, and peppermint farming is much greater than in grain-and-stock farming, because of the much wider price variations in the onion, celery, and peppermint markets, than in the grain and live stock markets.

Figure 10 shows the variations in the yearly average wholesale price of onions, celery, and peppermint for the last nine years. The farm price of these products varies even more than is indicated by the wholesale price range, for when market quotations are low and sluggish, commission men have to figure on a larger margin of profit than when prices are good. For example, in 1912 the average market quotation for onions was $0.49 per bushel, but buyers would only pay the farmer $0.20 to $0.30. So many farmers stored their crop that during the following winter the price went so low that thousands of bushels were hauled out to rot on the fields. As a result of this overproduction the acreage of onions was much reduced in 1913 and the price was correspondingly high. The variation in price for celery and peppermint, while not so great as for onions is such as to indicate that these, too, are hazardous types of farming.

Thus the profits of the special types of farming are very uncertain, while in grain-and-stock farming the profits are much more dependable from year to year. It is also highly probable that, through a period of years, the average profits in grain-and-stock farming will be larger than for any special type where similar amounts of capital and labor are involved.

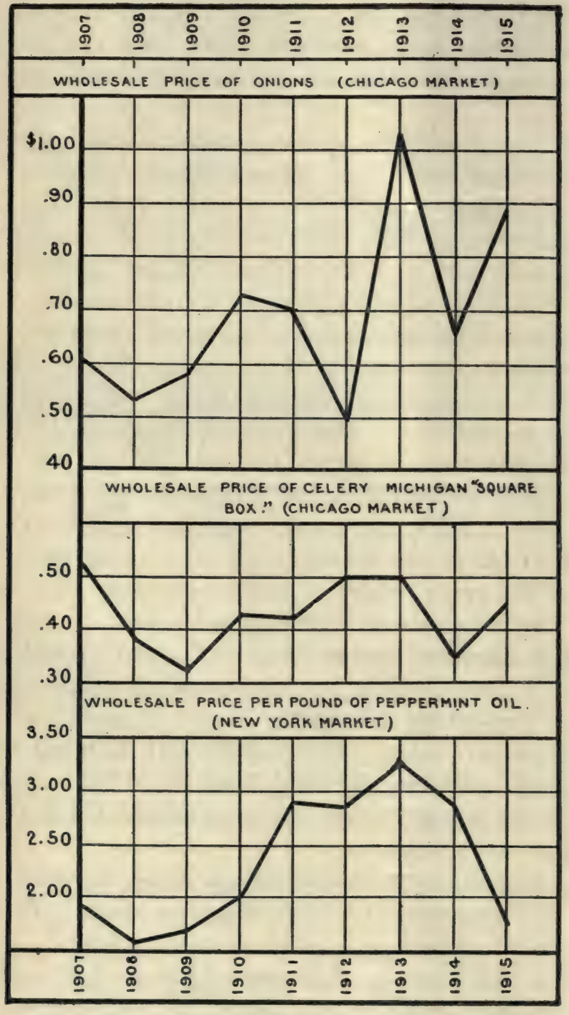

FIG. 10.—Variations in the average wholesale price of onions, celery, and peppermint, 1907 to 1915.

SIZE OF THE FARM BUSINESS AND PROFIT.

There are a number of ways of measuring the size of business on a farm and its effect on profits. In regions where a fairly uniform degree of intensity prevails, the total area of the farms, the area of improved land, and the crop area are all very accurate measures of size of business. But in regions where there are marked differences in intensity of farming, the sum of the interest on total capital, current expenses, depreciation and repairs, and value of the operator's labor[1] is the most accurate measure of the size of the farm business. This measure has been used in this study. In the tables it is called "Total expense." It might also be called the "Total cost of operating the farm."

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[1] In studying the effect of size of business on profit, the farms were divided into four groups according to total expense, as follows: Group I included all farms on which the total expense was less than $1,000; Group II, total expense from $1,000 to $2,500; Group III, from $2,500 to $4,000; and Group IV, total expense over $4,000. It will be noticed that the average total expense in Group II is almost exactly twice as large as in Group I, and also that the average total expense of Group III is again twice as large as Group II and that the same relation exists between Group IV and Group III.

The relation of size of business to farm income, labor income, and percentage earned on investment is shown in Table 11. The average farm incomes are directly proportional to the size of business as measured by total expenses and the average labor incomes increase at almost the same rate, but in general the percentage of income on investment remains the same for all sizes of business. The small farms made somewhat higher relative profits than large farms, but their actual labor incomes are small compared with the labor incomes of the larger farms.

TABLE 11.—*Relation of size of business to relative profit on 100 muck farms in northern Indiana and southern Michigan.*

Item.	Group I.	Group II.	Group III.	Group IV.
Number of farms	14	46	27	13
Average acreage	18.4	88.4	182.0	336.0
Average total capital	$2,884	$9,718	$23,651	$43,467
Average total expenses	$809	$1,632	$3,128	$6,502
Average farm income	$647	$1,136	$2,471	$4,899
Average labor income	$503	$650	$1,288	$2,732
Percentage of income on investment when value of operator's labor is deducted	10.0	8.0	8.2	9.7

DEVELOPMENT AND MANAGEMENT OF MUCK LAND.

In the development of new muck land and in establishing profitable types of farming upon it, a number of factors must receive careful consideration. Among these are distance to market, land clearing, drainage, soil management, and the selection of proper crops. Owing to the fact that muck soils are capable of supporting such a variety of types of farming, it is usually possible to adjust a system of farming to whatever conditions are encountered. Such staple crops as corn, hay, oats, and wheat are being grown more and more on muck land, and the acreage of these crops can be greatly extended without materially affecting prices. It is evident, therefore, that extensive types of farming should predominate on the greater part of this land.

DISTANCE TO MARKET.

All practical truck growers realize the importance of locating near a market or shipping point, but many beginners in the business make the mistake of locating so far from a market that the cost of hauling the products greatly reduces the profits or consumes them entirely.

The relation of distance to market to the value of muck land is shown in figure 11. The size of the farms increases with the distance to market, while the value per acre decreases rapidly. At 4 miles from market or shipping point this muck land has lost much of its value for trucking. At a distance of 5 or 6 miles from market muck land is worth as much for extensive as for intensive farming. This relation may be changed in the future by the introduction of cheaper methods of transporting bulky products from the farm to the market or shipping point, but it will always have much influence on type of farming and the utilization of new muck land, and should be a matter of important consideration for those who contemplate locating on this type of soil.

CLEARING MUCK LAND.

The cost of clearing muck land depends altogether upon the character of the native vegetation. A great deal of this land requires practically no clearing, being covered with a good sod of wild grasses and a few shrubs, as is shown in figure 12. This is true of very large areas of marsh land in Indiana, Michigan, and neighboring States. Muck land which has supported a growth of tamarack, black ash, or elm can usually be cleared at a cost of from $15 to $30 per acre, although in some cases the cost may be as high as $75 to $100 per acre. As a rule swamp-land stumps are shallow rooted and the soil is loose so that they can usually be pulled with a team and a simple stump-pulling device. (For further information on clearing land see United States Department of Agriculture Bulletin No. 91.)

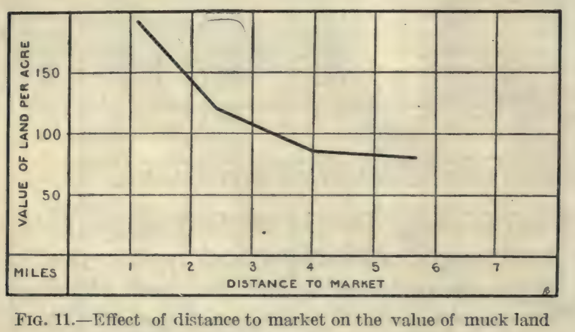

FIG. 11.—Effect of distance to market on the value of muck land per acre.

DRAINAGE.

All muck land is naturally low and wet and therefore must be drained artificially. In the case of large marshes, adequate outlet ditches must be provided. Laterals can be either open ditches or tile, but tile drains are much more convenient, though open ditches are much better than no drain at all. Seventy-five per cent of the farmers interviewed use tile drains, averaging 5 to 12 rods apart, the other 25 per cent depending on more or less incomplete open drainage systems. The smallest tile used for laterals averaged 5 inches, and since there is a tendency for fine particles of muck to sift into the tile at the joints, it does not seen advisable to use 4-inch tile except for very short laterals. Covering the tile with weeds or straw as they are laid will prevent this filling up to some extent.

The fairly rapid settling of new muck land, necessitates the laying of tile drains deeper than usual. If the fall permits, drains should be placed at a depth of 3½ to 4 feet. If they are placed nearer the surface, uneven settling of the soil will frequently throw the tile out of line, thus ruining the drain, and even if this does not occur it will become rapidly less efficient as the surface settles toward the level of the tile. Numerous muck fields were seen where tile drains which had been laid at a depth of 2½ feet 8 or 10 years before were being uncovered with an ordinary breaking plow.

It is sometimes advisable to dig open ditches, as a temporary measure, to be replaced later by a permanent system of tile drains. Where higher land borders on muck, it is very important to lay a drain around the border to catch the seepage from the high lands. If this is not done there will be wet spots just inside the border of the muck.

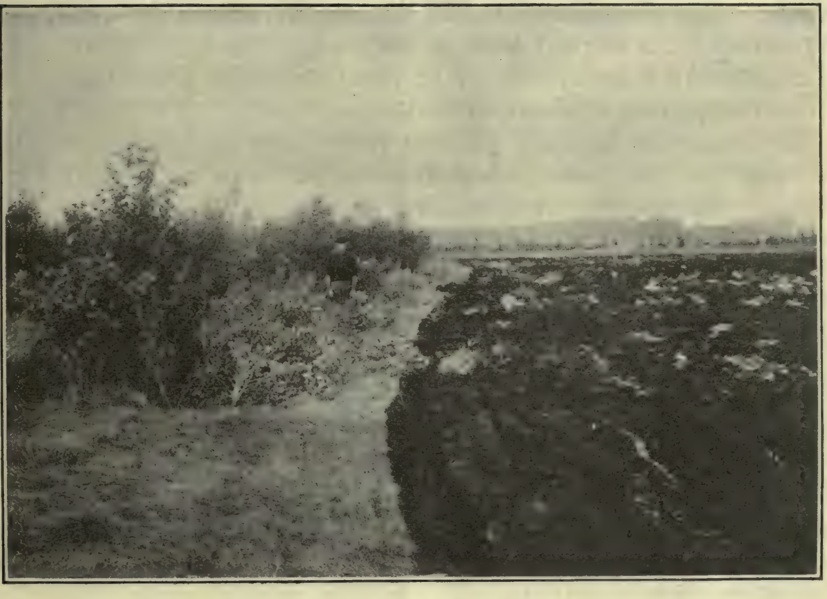

FIG. 12.—Much of the muck land can easily be cleared and put under cultivation.

A definite plan should be worked out and followed in all drainage work. Usually time and money will be saved by securing the services of a competent drainage engineer.

SOIL MANAGEMENT.

The muck soil of northern Indiana and southern Michigan shows a wide range of variations. In some places it is as deep as 10 to 20 feet, the lower layers being composed of peat in various stages of decomposition, while in other places the muck grades off toward the higher surrounding land and is intermixed with a large proportion of sand or clay, resembling black loam, and by some writers characterized by the term "marsh border" soils.

The native vegetation on these soils varies as much as the soils themselves. In some marshes black ash and elm predominate, some support a growth of tamarack, and still others were originally open prairies covered by a heavy growth of marsh grasses and a great variety of mosses, weeds, and shrubs. Occasionally huckleberry and cranberry marshes are found. Still less frequently small areas are covered with dewberry briars. These latter types of vegetation usually grow on soils that are very deficient in lime.

The average depth of the muck on all the farms studied was about 5 feet. When first broken up this soil is usually loose and spongy gradually decomposing upon exposure to the air by drainage and tillage. This results in continued settling, the amount of which will depend upon the original depth of the muck. The farms studied had been farmed for an average of 12 years, and during that time had settled at the rate of about an inch a year.

Muck soils are radically different from other types, owing to the fact that they have been formed almost wholly from the decay of vegetation, while the heavier types have been formed by the processes of rock weathering. Clay, loam, and sandy soils are frequently in need of organic matter and nitrogen, while muck soils are usually lacking in certain mineral constituents, especially potash and phosphates, and occasionally lime. On most muck soils in this region potash is the most important fertilizer ingredient needed, though the application of available phosphates usually produces additional beneficial results.

Farm experience, field experiments, and soil analyses have all clearly demonstrated that, excluding drainage, the question of fertilizing and manuring muck soil is the most important factor in determining crop production on muck land. The fact has further been substantiated by this study.

Many muck soils have produced fairly good crops for a year or two, after which production diminishes rapidly unless fertilizers or manure are applied. Some muck soils are so deficient in potash that they will not produce anything even when first broken up, so that the most experienced muck farmers use fertilizers or manure from the very start without waiting to see if a crop can be produced without reinforcing the meager supply of mineral plant food already in the soil, thereby running the risk of losing a crop.

Nitrogen is present in all muck soils in abundance, but it is probably fortunate that only a small portion of it is available for any one year. On new muck land and for intensive crops it may occasionally be profitable to use fertilizers containing some nitrogen, since the bacteria which render soil nitrogen available are not always present in sufficient numbers in new muck. It often happens that on new muck lands manure is especially valuable since it inoculates the soil with bacteria, at the same time adding considerable mineral plant food in fairly available forms. But after muck land has been farmed for a few years it is doubtful whether the application of nitrogen-carrying fertilizers is necessary.

Potash alone is usually applied to muck land in the form of commercial muriate of potash. The more expensive sulphate of potash is thought by some to produce better quality in onions, potatoes, and other truck crops, but these claims do not seem to justify the extra expenditure for the higher priced form of potash. On muck soil which has not been previously fertilized or manured, it is customary to apply from 100 to 200 pounds of muriate of potash per acre for extensive, or corn and small grain crops, and from 200 to 400 pounds per acre for truck or intensive crops. This application is repeated every two or three years, or a smaller amount is applied every year. This treatment usually gives excellent results, the yields frequently being increased from 50 to 200 per cent over the yields of similar untreated land. A large amount of ready mixed commercial fertilizer is also used on the muck soil in this region. The potash content of these fertilizers ranges from 8 to 15 per cent and the available phosphate from 5 to 10 per cent. From 150 to 300 pounds per acre are used on extensive, and from 300 to 1,000 pounds or more per acre on intensive crops. The phosphate induces earlier ripening of crops, better quality, and a somewhat higher yield. It is usually more economical to buy potash and acid phosphate separately than to use ready-mixed goods.

At the present time (1916) the supply of commercial potash in this country is so low that very little is available for fertilizer and the price is prohibitive. Every effort should be made to conserve the potash already in the soil. Farm manures and crop residues have a relatively higher value at present than when the fertilizer supply is normal and will give excellent results when applied to muck land. Farm manure contains on the average about one-half of 1 per cent, and fresh straw from one-half to 1 per cent of potash, which is readily soluble in water and available for plant growth. It is, therefore, very important to prevent the undue leaching of manure in order that it may give the best possible results when applied to muck land. Many growers prefer manure to commercial fertilizer for truck crops. For general crops, with present prices for potash (1916), six to eight tons of manure per acre in some instances may be more profitable on muck land than on any other soil type, since without potash some muck soils produce very light crops.

In order to obtain a good seed bed, deep muck should be compacted by means of a roller, the heavier the better. Many muck farmers roll several times with an ordinary roller, sometimes weighted with stones, while on a few of the larger farms extra heavy rollers weighing from 3,000 to 5,000 pounds, and pulled either by a tractor or by horses, have given excellent results. In the case of spring-planted crops it is claimed that danger from frost is much reduced when the soil has been thus compacted.

CROPPING SYSTEMS.

In the case of muck soils there is little need for growing crops that replenish the supply of nitrogen and organic matter in the soil, hence the growing of legumes is not so essential. Rotation of crops, or rather a change of crops on muck soil is desirable, however, as a means of controlling insect pests and plant diseases, and of securing a proper seasonal distribution of farm labor. Farmers who are specializing on crops like onions, celery, or peppermint do not care to give much attention to their minor crops, and hence usually change crops only when their principal crop is threatened with some insect or plant disease.

Of the general crops grown on muck soil, corn is the most important, though hay and grain are usually profitable. A rotation consisting of corn two years, oats and wheat one year each, and hay two years, is well adapted to this soil and provides a good distribution of labor, especially if a sufficient amount of live stock is kept to furnish some work during the winter months. Some corn, hay, oats, and all of the wheat can be sold, which, together with receipts from live stock, will provide enough diversity to insure a fair degree of stability in the farm income to be derived from farming muck lands.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE FALSE CHINCH BUG[1] AND MEASURES FOR CONTROLLING IT.

By F. B. MILLIKEN, *Scientific Assistant, Truck Crop and Stored Product Insect Investigations.*

INTRODUCTORY.

The grower or gardener of the plateau region east of the Rocky Mountains is often alarmed to note that his sugar beets or cabbages, which a day or two previously had been apparently free from insects, are swarming with minute, active, grayish bugs which, by their numbers, threaten the profitable harvesting of his crop. These insects belong to the species commonly known as the false chinch bug.

A severe outbreak of this pest, especially in Kansas and Colorado, during May and June, 1916, makes it desirable to inform market gardeners and sugar-beet growers of the best means that have been developed for combating it in that region. The ability to recognize the insect when it appears and a knowledge of its life history and habits are essential to the successful application of remedial measures.

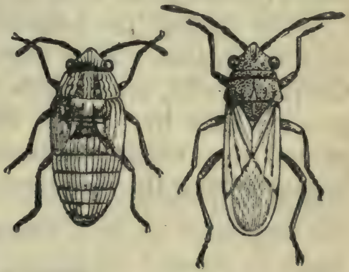

FIG. 1.—The false chinch bug (*Nysius ericae*): Adult at right, last stage of nymph at left. Highly magnified. (Adapted from Riley.)

The adult false chinch bug (fig. 1) is about one-eighth of an inch long and one-twentieth of an inch wide, or about half the length and half the width of a grain of wheat. To one familiar with the true chinch bug it is sufficient to say that the false chinch bug resembles it, including the offensive odor, but is more slender, and there is no black on the wing covers. Others will recognize the insect from the description given above and its dull gray body, which is black beneath and half covered by its whitish wings. The young are wingless and may be recognized from their occurrence with the adults.

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[1] *Nysius ericae* Schill. (*N. angustatus* Uhl.); family Lygaeidae, order Hemiptera, suborder Heteroptera.

GENERATIONS AND FOOD HABITS.

The number of generations, or "broods," produced annually depends upon the temperature, the latitude, and the season. At Garden City, Kans., there are at least five. The early spring and the late fall broods deposit their eggs in the surface cracks of the soil and in pulverized soil. During the hottest weather they thrust their eggs among the clustered parts of plants, such as the heads of the great-flowered gaillardia,[1] the flowering parts of carpet-weed,[2] and the glumes of "stink-grass" or strong-scented love-grass.[3]

When the young are hatched they feed almost exclusively on weeds, especially on pepper-grass,[4] shepherds-purse,[5] thyme-leaved spurge,[6] Russian thistle,[7] and sage-brush.[8] *Monolepis nuttalliana* (R. & S.), which has no common name, is also included in the list of food plants. At maturity the adult bugs scatter over all vegetation. If drought prevails they are compelled to gather on cultivated crops, preferring crucifers or cole crops and beets, but they have been observed feeding on corn and kafir. Seed beets during the second year's growth suffer especially.

While feeding, the false chinch bugs congregate in large numbers on a few plants. Here they remain until the sap is exhausted and the plants wilt, after which they collect on such other plants as are growing close by. When disturbed, the adults dart quickly to the ground or to adjoining plants. Those alighting on the ground crawl to plants when the disturbance ceases.

CONTROL MEASURES.

DESTRUCTION ON WILD PLANTS.

The false chinch bug may frequently be controlled by destroying it on its wild food plants, and since the effect on such plants need not be considered, this may be accomplished satisfactorily by burning, which is particularly effective when there is enough dead and dry vegetation on the ground to carry fire. This will compass the destruction of many of the adults as well as great numbers of the young. Burning may be facilitated by scattering straw or similar dry material over the infested area, and when the insects are massed on weeds or clumps of wild vegetation they can be destroyed by the use of a strong-blast gasoline torch. The best type of torch, costing about $18, should be employed for this purpose. The ordinary plumber's torches are not satisfactory for field work, as they are almost certain to become overheated so that the operator can not use them, and in a short time the heat destroys their usefulness. The value of hand torches for insecticidal purposes is extremely limited, and growers are apt to expect too much from their use. They are applicable to only a few forms of insects, of which the present species is one.

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[1] *Gaillardia pulchella* Foug.

[2] *Mollugo verticillata* L.

[3] *Eragrostis major* Host.

[4] *Lepidium virginicum* L.

[5] *Bursa bursa-pastoris* L.

[6] *Chamaesyce serpyllifolia* Pers.

[7] *Salsola tragus* L.

[8] *Artemisia tridentata* Nutt.

DESTRUCTION BY CONTACT POISONS.

Adults which attack cabbages or sugar beets are readily killed by a spray of about 1 pound of fish-oil soap or strong laundry soap to 5 gallons of water. On turnips and radishes such a solution is too strong, and a solution of 1 pound of soap in 10 gallons of water with 1 part of nicotine sulphate in 1,000 parts of water should be used. Other crops whose resistance to strong soap solutions is not known should be treated with the latter solution. Those insects that survive the first treatment soon collect on other plants, where they may be destroyed by another spraying.

To spray an infested plant successfully it must be approached without disturbing the bugs and the nozzle held high enough above it to allow the cone of spray to surround the plant. The spray should then be turned on and the nozzle gradually lowered in order to wet the bugs on the ground, after which it should be directed among the leaves to wet those which are sheltered. It is best to attach the nozzle to the end of a 4-foot rod and to set it at right angles to the rod by means of an elbow.

CAPTURING THE BUGS ON STICKY SHIELDS.

A sticky shield for capturing the false chinch bug on plants that can not be sprayed has been developed by Mr. H. O. Marsh, of the Bureau of Entomology, and Mr. W. W. Tracy, jr., Bureau of Plant Industry, working at Rocky Ford, Colo. This shield consists of burlap, or gunny, stretched over a back of thin boards and protected by poultry netting which is tacked to end pieces 1 by 4 inches. Crude petroleum is spread on the burlap and sprinkled with kerosene to soften it. The shield is then held alongside the infested plant and the bugs driven onto it by striking the other side of the plant with a beater made of a piece of canvas tacked to a flat handle. The netting prevents the plant from brushing the oil off of the shield, but does not interfere with the bugs darting against it and sticking in the oil, or at least becoming sufficiently smeared to insure their death. The diagram (fig. 2) illustrates the construction of a shield and beater.

A convenient size of shield is 24 by 30 inches, and of the beater, 14 by 14 inches. Such a shield can be operated by one man, but better results can be secured by two. The petroleum and kerosene must be renewed frequently.

To combat this pest successfully and to prevent losses to his crops the grower should apply remedies at the very beginning of an attack. If the outbreak covers a large area, all growers in the locality should cooperate, as crops may be attacked anywhere in the neighborhood.

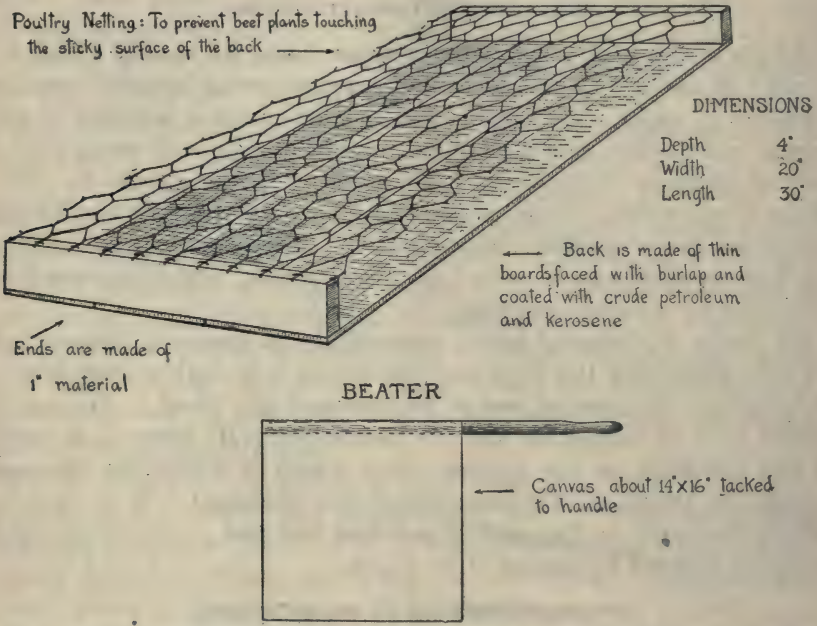
Poultry Netting: To prevent beet plants touching the sticky surface of the back
DIMENSIONS
Depth 4"
Width 20"
Length 30"
Back is made of thin boards faced with burlap and coated with crude petroleum and kerosene
Ends are made of 1" material
BEATER
Canvas about 14"x16" tacked to handle

FIG. 2.—Sticky shield and beater for destruction of false chinch bugs on flowering beets. (Original.)

After the adult bugs have collected on a certain area, their destruction will usually end the damage by that brood. However, if others of the same or of succeeding broods are driven on later by the dying of adjacent vegetation, another application of remedial measures will be necessary. The more completely the earlier generations in a given year are destroyed, the less will be the damage by later generations during the same year; and the more thoroughly control measures are practiced during any year, the less is the danger of severe outbreaks the next year.

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FARMERS' BULLETIN

WASHINGTON, D. C. 763 NOVEMBER 29, 1916

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

ORCHARD BARKBEETLES AND PINHOLE BORERS, AND HOW TO CONTROL THEM.

By FRED E. BROOKS,

Entomological Assistant, Deciduous Fruit Insect Investigations.

INTRODUCTION.

This bulletin gives a brief account of the principal barkbeetles and related species that attack apple, peach, plum, and other orchard trees and describes the methods most effective in controlling them. These troublesome insects are small beetles which belong to two

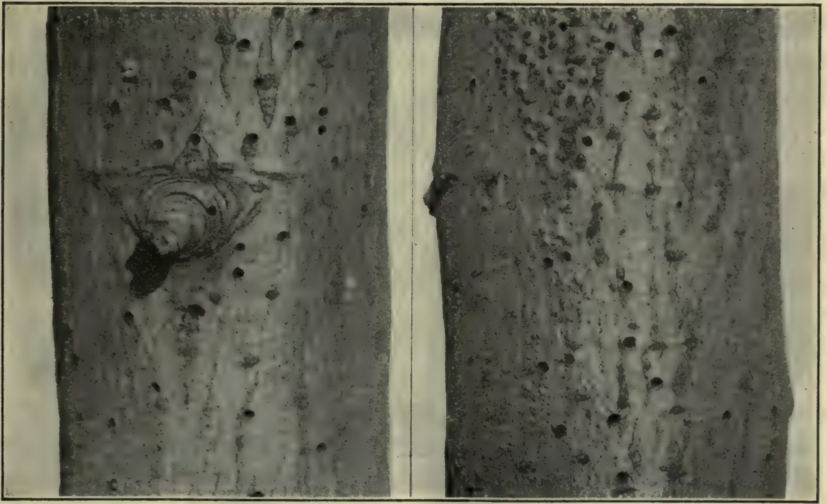

FIG. 1.—Exit holes of the fruit-tree barkbeetle in sections of trunk of young apple tree. About natural size. (Original.)

NOTE.—This bulletin is of interest to fruit growers generally, especially in the territory east of the Rocky Mountains.

groups: First, and most commonly injurious, the shot-hole borers or barkbeetles; second, the pinhole borers or ambrosia beetles. To the first group belong the fruit-tree barkbeetle[1] (fig. 2), which occurs throughout the United States east of the Mississippi River, in many localities farther west, and in Canada, and the peach-tree barkbeetle[2] (fig. 7), which has been found in the States of New Hampshire, New York, Pennsylvania, Maryland, the Virginias, North Carolina, Ohio, and Michigan, and in Ontario, Canada; to the second group belong the apple wood stainer[3] (figs. 14, 16) and a related species[4] (fig. 15), and the pear-blight beetle[5] (fig. 17), of the Eastern United States. The species which are the most generally distributed members of the two groups in the United States and those of greatest importance from the standpoint of injury to deciduous fruit trees[6] are discussed in the following pages. Each of them attacks several kinds of fruit trees, although the peach-tree barkbeetle appears to infest only the trees that bear stone fruits.

NATURE OF INJURY CAUSED BY SHOT-HOLE AND PINHOLE BORERS.

The shot-hole borers or barkbeetles burrow into the bark and slightly into the wood in both the larval or grub stage and the adult or beetle stage and, by extending their burrows in great numbers between the bark and sapwood, destroy that vital part of the tree known as the cambium. As a rule, sound, vigorous bark is not attacked, injury being confined to such trees as have had their normal health impaired by some other agency. Cases are not unknown, however, in which the beetles have multiplied greatly in diseased and dying wood and have then extended their attacks to near-by healthy trees, causing extensive loss. The female beetles, in entering the bark to deposit their eggs, and, also, all the newly transformed beetles in leaving their pupal quarters in the wood, make small but rather conspicuous round holes in the bark. Numerous punctures of this kind very frequently appear in trees within a short time after they have been seriously weakened or vitally injured by some cause not connected with these insects. On account of the fact that these entrance and exit holes are apt to attract the attention of orchard owners, it is probable that the loss of trees is sometimes attributed directly to injury by barkbeetles, when, in reality, death is due primarily to some weakening of the trees caused by root or crown diseases, overbearing, starvation, injury to roots or base of trunk by other insects, mice, or rabbits, injury by the San Jose scale, or some other cause more or less obscure.

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[1] *Scolytus rugulosus* Ratz. [2] *Phloeotribus liminaris* Harris. [3] *Monarthrum mali* Fitch. [4] *Monarthrum fasciatum* Say. [5] *Anisandrus pyri* Peck.

[6] Another species, *Stenoscelis brevis* Boh., of somewhat similar appearance but belonging to another family of beetles (Calandridae), is frequently received from fruit growers who suppose it to be injurious. This insect is common in dead wood of apple and some other trees. The beetle is black and about one-eighth of an inch in length. The larva is white and has a row of minute black spots on each side So far as is known at present this species does not feed in living wood and therefore does not occur in orchards of perfectly sound trees.

The pinhole borers or ambrosia beetles, which are somewhat similar to the foregoing in size, color, and form, penetrate farther into the wood than do the barkbeetles, and, like them, prefer to attack diseased or dying trees. Beetles of this group sometimes bore into the twigs of live apple and pear trees, causing a dying back of the tips as though from twig blight. They have also been recorded as injuring nursery trees by boring into the trunk and causing that part of the tree above the point of injury to die.

THE FRUIT-TREE BARKBEETLE.[1]

HISTORY AND GEOGRAPHIC RANGE.

The fruit-tree barkbeetle, or shot-hole borer (fig. 2), probably was introduced accidentally into America from Europe some time previous to the year 1877. The insect is now known to occur throughout practically all the United States east of the Mississippi River, and has become established in many localities to the west and also in Canada, although it does not appear at the present time to have reached the Pacific Coast States.

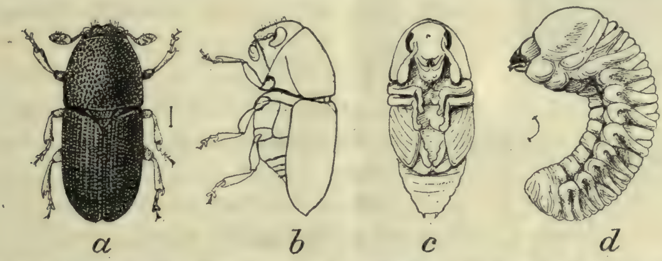

Fig. 2.—The fruit-tree barkbeetle (*Scolytus rugulosus*) : *a*, Adult, or beetle ; *b*, same in profile ; *c*, pupa ; *d*, larva. All enlarged about 10 times. (Chittenden.)

TREES ATTACKED.

The fruit-tree barkbeetle attacks and breeds in most of our cultivated deciduous fruit trees and in several species of uncultivated pome and stone fruits. The list of food plants is known to include apple, pear, plum, peach, cherry, quince, apricot, nectarine, wild cherry, chokecherry, wild plum, mountain ash, loquat, and service berry. Under favorable conditions multitudes of the beetles may develop in the wild trees mentioned and migrate in destructive numbers to near-by cultivated orchards.

LIFE HISTORY AND HABITS.

The adult, or beetle (fig. 2, *a*, *b*), is about one-tenth of an inch in length and of a dark brown or black color with dull reddish markings on the legs, about the head, and on the tips of the wing covers. In the spring, from April to June, according to latitude, the beetles appear on suitable trees and begin to excavate brood chambers between the bark and sapwood. In preparing the chamber the female beetle gnaws a round hole, about one-twentieth of an inch in diameter, through the bark and then extends a slightly enlarged burrow (fig. 3, *a*), 1½ or 2 inches in length, nearly or quite parallel with the grain of the wood. This burrow or brood chamber is made partly in the bark and partly in the wood, and during the process of its construction small niches are mined out on both sides, in each of which a minute white egg is deposited. A single female will produce, on an average, from 75 to 90 eggs.

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[1] *Scolytus rugulosus* Ratz. ; order Coleoptera, family Scolytidæ.

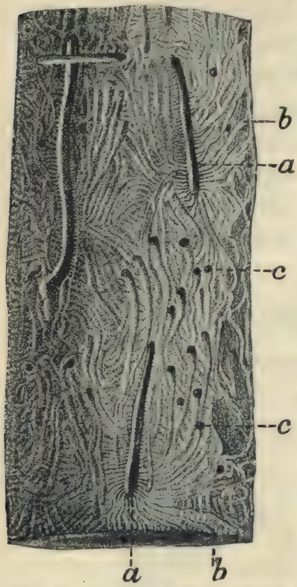

FIG. 3.—Galleries of the fruit-tree barkbeetle on twig under bark: *a*, *a*, Main galleries; *b*, *b*, side or larval galleries; *c*, *c*, pupal cells. Natural size. (Ratzeburg.)

The eggs hatch in 3 or 4 days. The small, footless, grublike larvæ are white with reddish heads and attain, when full grown, a length of about one-tenth of an inch. The larvæ (fig. 2, *d*) burrow between the bark and sapwood, first at right angles away from the brood chamber, and form centipede-like figures in the wood which are disclosed by removing the bark. (Fig. 4.) The larval burrows when completed average 3 or 4 inches in length and are filled with dust-like frass of a reddish-brown color. After feeding from 30 to 36

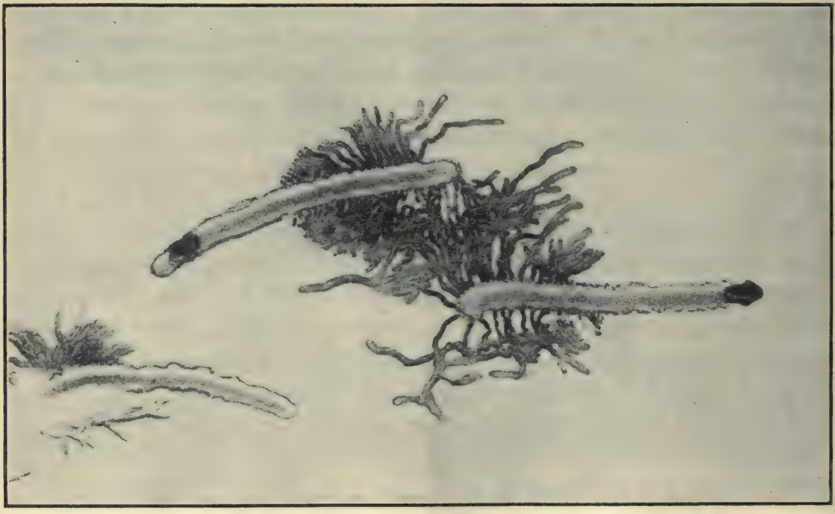

FIG. 4.—Galleries of the fruit-tree barkbeetle under apple bark, showing adult females in brood chambers. Enlarged. (Original.)

days the larvæ attain full growth and pupate within specially constructed cells just beneath the surface of the sapwood.

The pupal period (see pupa, fig. 2, *c*) lasts from 7 to 10 days, and at its termination the beetles that have developed gnaw out through the bark, making their escape through small, round holes (fig. 1) similar to the entrance holes made previously by the females.

Within a few days after emerging these young beetles begin to deposit eggs, giving rise to a second brood of larvæ which feed in the trees during the latter part of the season. In approximately the northern half of the territory over which this barkbeetle is found the second-brood larvæ winter in the trees, pupating early in the spring following. In the southern part of the territory, however, these larvæ become adults before winter, escape from the trees, and deposit eggs, providing thereby for a third brood of larvæ. Thus, in the Northern States there are two generations of the insect annually, while in the South three and possibly four generations may occur within the year.

FEEDING HABITS.

Except in cases where the barkbeetles are excessively abundant, they do not normally attack and breed in healthy trees, neither do they feed and deposit their eggs in wood that is entirely dead. Trees that have been greatly weakened by unfavorable conditions, or that are in the act of dying, afford the most acceptable food for the beetles and their larvæ. Where there is a great quantity of dying wood, such as prunings and trees that have been injured by the San Jose scale, the yellows, freezing, or root troubles, the beetles will breed in great numbers, and after their supply of preferred food has been exhausted they will sometimes attack vigorous trees that may be growing in the vicinity. At first the attacks may not make much impression on sound trees, but a continuation of the injuries may eventually weaken the trees to such an extent that they become acceptable food for the larvæ, which can then develop within the bark, and after this the death of the tree is reasonably sure to follow very soon.

When healthy peach, plum, cherry, and other stone fruit trees are attacked, the flow of gum (fig. 5) will often check the entrance of the beetles and will prevent the development of larvæ in cases where eggs are deposited. The formation of gum at the wounds will diminish, however, as the tree is weakened, and after a period during which slight but numerous injuries have been inflicted by the beetles the condition of the tree may become exactly right for the deposition of eggs and the growth of the larvæ. The trunk, branches, and twigs of suitable trees are attacked and all the inner bark and the surface of the sapwood converted to dust in a very short time by the primary wounds of the beetles and the more extensive burrows of the numerous larvæ. (See fig. 6.)

NATURAL ENEMIES.

Several kinds of four-winged insect parasites attack and destroy the barkbeetle larvæ, probably the most abundant and effective being a small species known technically as *Chiropachys colon* L. Minute nematode worms of an undetermined species have been found inhabiting the bodies of the larvæ, but to what extent, if any, they reduce the number of insects, has not been determined. Among the birds, woodpeckers remove many of the insects from infested trees, especially during the winter months.

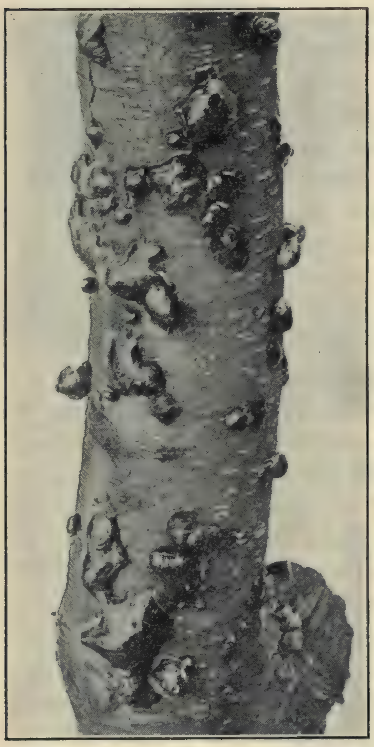

FIG. 5.—Gum exuding from wounds on peach limb caused by the fruit-tree barkbeetle. Reduced. (Original.)

THE PEACH-TREE BARKBEETLE.[1]

HISTORY AND GEOGRAPHIC RANGE.

The peach-tree barkbeetle (fig. 7) is a native of America and has been recognized as an enemy of peach trees since about the year 1850. It first came into prominence as a supposed cause of the disease of peach trees known as "yellows," a supposition which was not borne out by subsequent investigations. The insect is very similar in form and habits to the fruit-tree barkbeetle, although it does not attack so great a variety of trees. Peach, cherry, and wild cherry are its principal food plants, although it is known to work on plum when no other food is available.

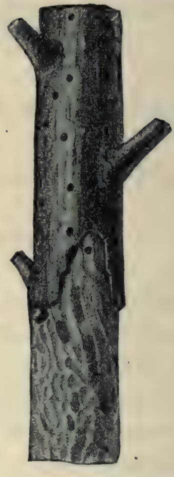

FIG. 6.—Twig of apple killed by the work of the fruit-tree barkbeetle. Natural size. (Chittenden.)

At the present time the species is known to occur in the States of New Hampshire, New York, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, Ohio, and Michigan, and in the Province of Ontario, Canada. It is probable that it may be found in States other than those mentioned.

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[1] *Phloeotribus liminaris* Harris; order Coleoptera, family Ipidae.

As a rule, this beetle, like the one described previously, prefers to attack diseased and dying wood, and the known cases of serious injury by it to healthy orchards are not numerous. There are records, however, of its doing great damage to peach orchards in Ohio, New York, and Ontario, and the history of the species indicates that where breeding conditions are favorable it may multiply and become at any time a menace to peach, and possibly cherry orchards.

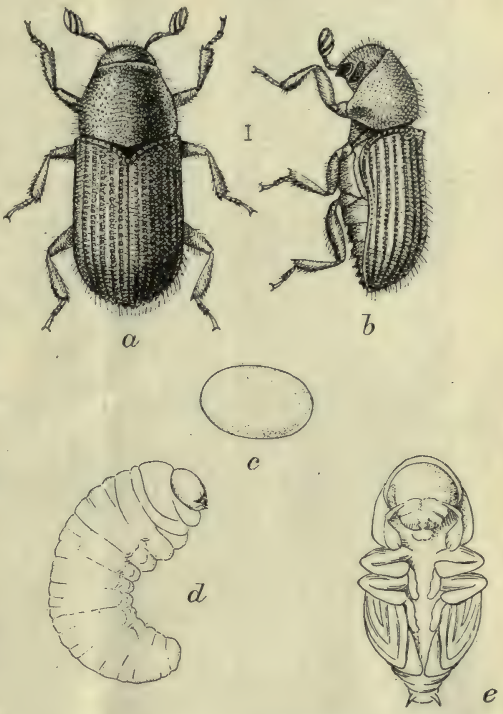

FIG. 7.—The peach-tree barkbeetle (***Phloeotribus liminaris***): ***a, b,*** Adult, or beetle, dorsal and lateral views; ***c,*** egg; ***d,*** larva; ***e,*** pupa. Greatly enlarged. (H. F. Wilson.)

LIFE HISTORY AND HABITS.

Unlike the fruit-tree barkbeetle, this insect winters in the tree as an adult. This adult, or beetle (fig. 7, *a*, *b*), is a little less than one-tenth of an inch in length and in color light brown to nearly black. Some of the beetles, which transform to the adult stage late in the fall, winter within their pupal cells in dead or dying trees; others, which transform earlier in the fall, leave the host tree and bore into healthy or unhealthy trees, forming hibernation cells just beneath the outer layer of bark. These hibernation cells are made at the inner terminus of burrows averaging about half an inch in length. Often great numbers of such burrows are made in growing trees, and during the following season there will be a copious exudation of gum from the numerous wounds similar to that caused by the fruit-tree barkbeetle (see fig. 5). The beetles, after leaving their hibernation quarters in the spring, make short burrows in healthy trees, either to obtain food or in an attempt to form brood chambers. The constant flow of sap from such wounds eventually weakens the trees to such an extent that brood chambers can be constructed without interference from gum formation, after which the larvæ make short work of the trees.

The beetles leave their hibernation cells early in the spring and migrate to other trees, brush heaps of prunings, or any suitable wood wherein eggs can be deposited. The female bores into the bark, forming a hole very similar to that made by the fruit-tree barkbeetle, but distinguished from it by the particles of excrement, held together by fine threads of silk, which partly fill the mouth of the burrow or hang therefrom. The brood chamber (see figs. 8, 9) may be anywhere from 1 to 2½ inches in length. It may be told at a glance from that of the species described previously by the fact that almost invariably it is made to cross the grain of the wood transversely, instead of extending parallel with it, and that there is a short side tunnel branching from the main chamber near the inner end. This side branch enables the female to turn around within the burrow and is occupied by the male at the time of mating.

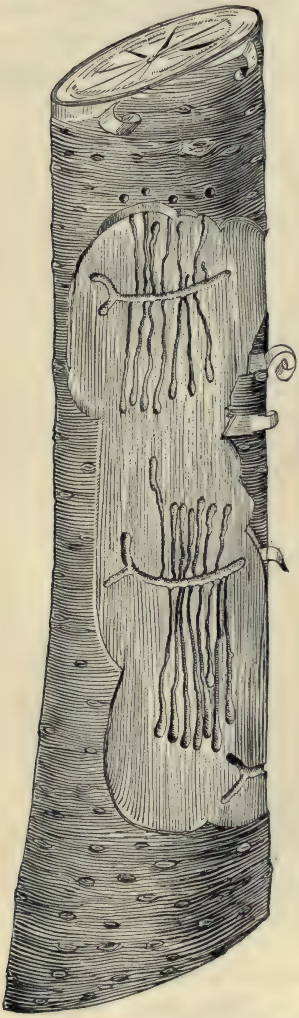

Fig. 8.—The peach-tree barkbeetle in wood of peach tree: Brood chambers and larval galleries. (H. F. Wilson.)

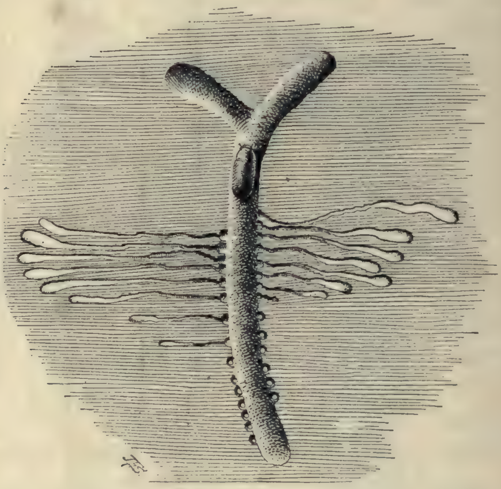

Fig. 9.—The peach-tree barkbeetle: Brood chamber with egg pockets and larval galleries in wood of peach tree. Lakeside, Ohio, May 18, 1908. Enlarged. (H. F. Wilson.)

The small, white eggs (fig. 7, *c*) are deposited in little pockets excavated from the walls of the brood chamber (see fig. 9), from

80 to 160 eggs being placed by a female in a single chamber. Eggs (fig. 7, *c*) from the first generation of beetles require from 17 to 20 days to hatch. The larvæ (fig. 7, *d*) bore at right angles away from the brood chamber, forming burrows from 1½ to nearly 3 inches in length. They are white, often with a pinkish cast due to the contents of the digestive tract, and have a yellowish head and darker mouth parts. In from 25 to 30 days they attain full growth and then pupate within the bark. From 4 to 6 days are passed in the pupal stage (fig. 7, *e*), after which transformation to beetles takes place. The adults of this generation issue about midsummer (see fig. 10) and provide eggs for a second generation, the beetles of which appear in the fall and hibernate as has been described. During the summer and fall the two generations overlap so that all stages of the insect may be found in trees at one time.

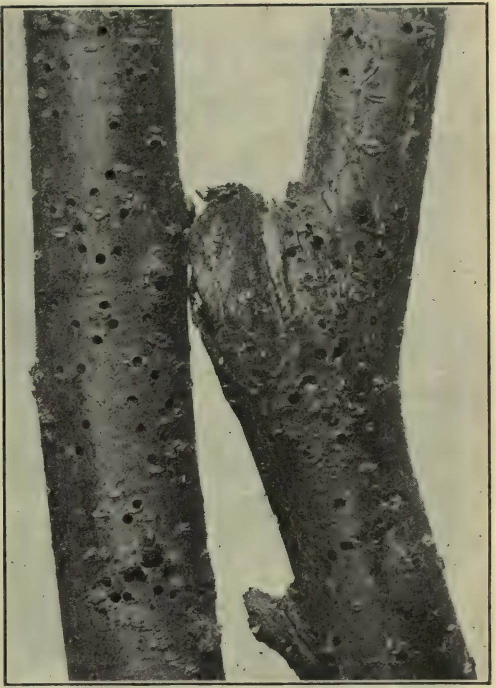

FIG. 10.—Exit holes in peach limbs made by adults of the peach-tree barkbeetle. Natural size. (Original.)

CONTROL OF THE FRUIT-TREE AND PEACH-TREE BARKBEETLES.

The first and most important point in connection with the control of these two species of barkbeetles is the elimination of breeding places. As has been shown, both species breed only in unhealthy wood, and where there is an abundance of such wood they will multiply in numbers limited only by the food supply. Trees and branches affected as follows have been observed to be favorite breeding places: Trees dying from neglect and starvation, from attacks of the San Jose scale, infection of "yellows," injury to roots and base of trunk by mice and rabbits, injury by blight and sun scald, and other diseases of roots, trunk, and branches, and injury by roundheaded apple-tree borers; trees whose branches have been broken down by storms or loads of fruit, or any agency or condition that will cause unhealthy or dying wood. (See figs. 11 and 12.) Such wood should always be eliminated, either by restoring it through proper treatment to a normal and healthy condition or by burning. Not only must such wood be guarded against within the orchard, but a lookout should be maintained of land adjacent to orchards, where sickly seedling apple, peach, wild cherry, wild plum, serviceberry, crab apple, or other trees susceptible to infestation may form breeding centers for the beetles. Where all such breeding places can

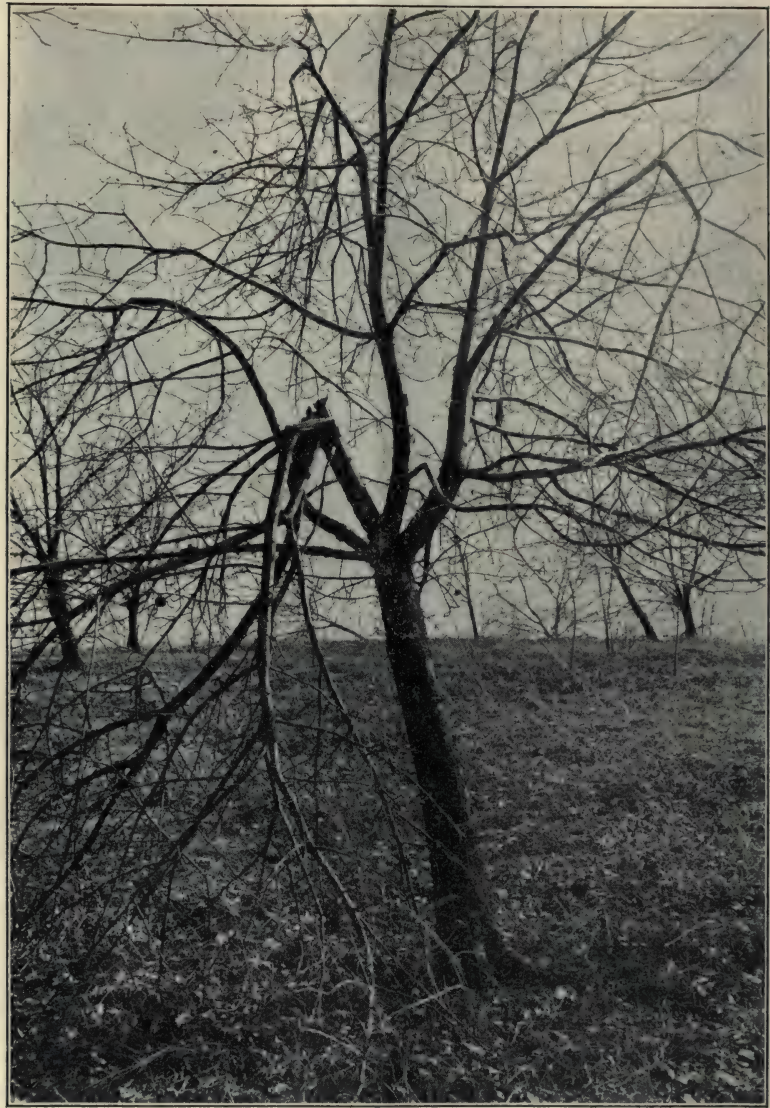

FIG. 11.—Branches of apple tree broken by overbearing. The fruit-tree barkbettle was breeding in great numbers in the broken branches. (Original.)

be removed the danger of attacks by the beetles on healthy trees will be reduced to the minimum.

Trees of stone fruits, like peach, plum, and cherry, which are infested and from which the gum still exudes may often be saved by the prompt application of remedies. They should first be cut back severely and then the soil about them cultivated and dressed liberally with barnyard manure or commercial fertilizer. This will stimulate growth and assist the tree in overcoming the injury. A thick

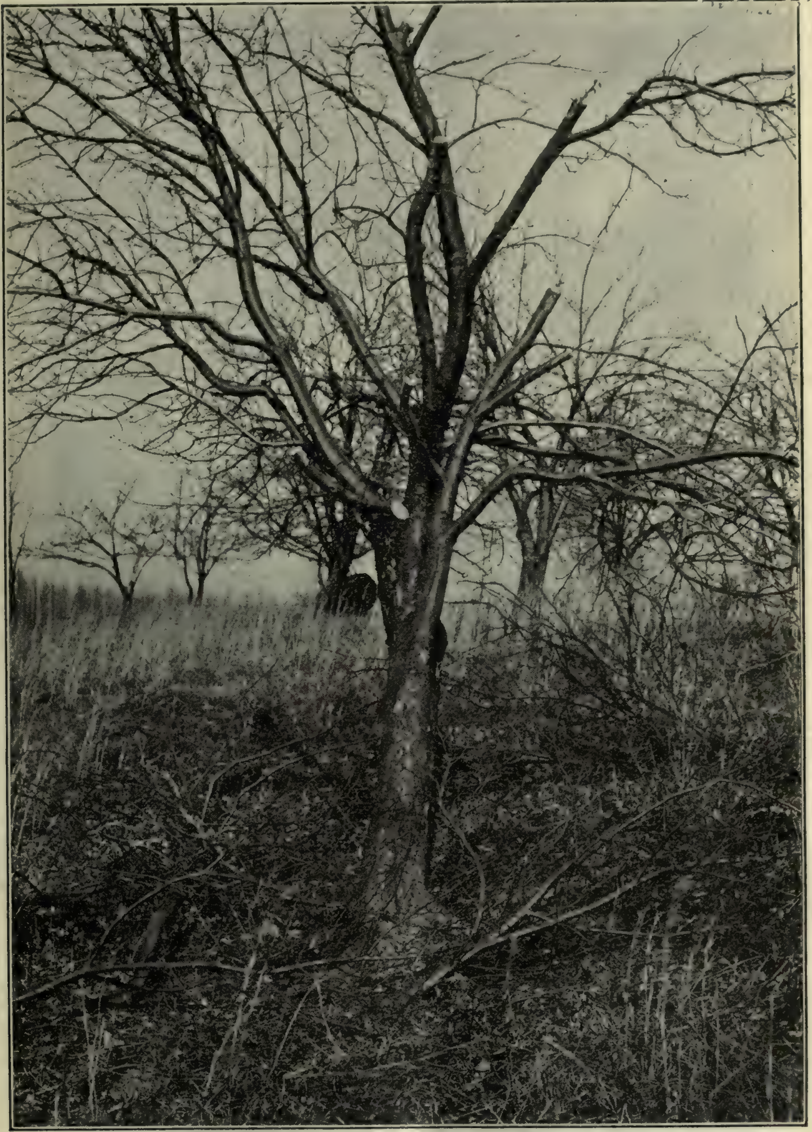

FIG. 12.—Branches left lying on the ground under a top-worked apple tree. Numbers of the fruit-tree barkbeetle were breeding in these branches. (Original.)

coat of whitewash (fig. 13) should then be applied. In cases of serious infestation it may be necessary to apply as many as three

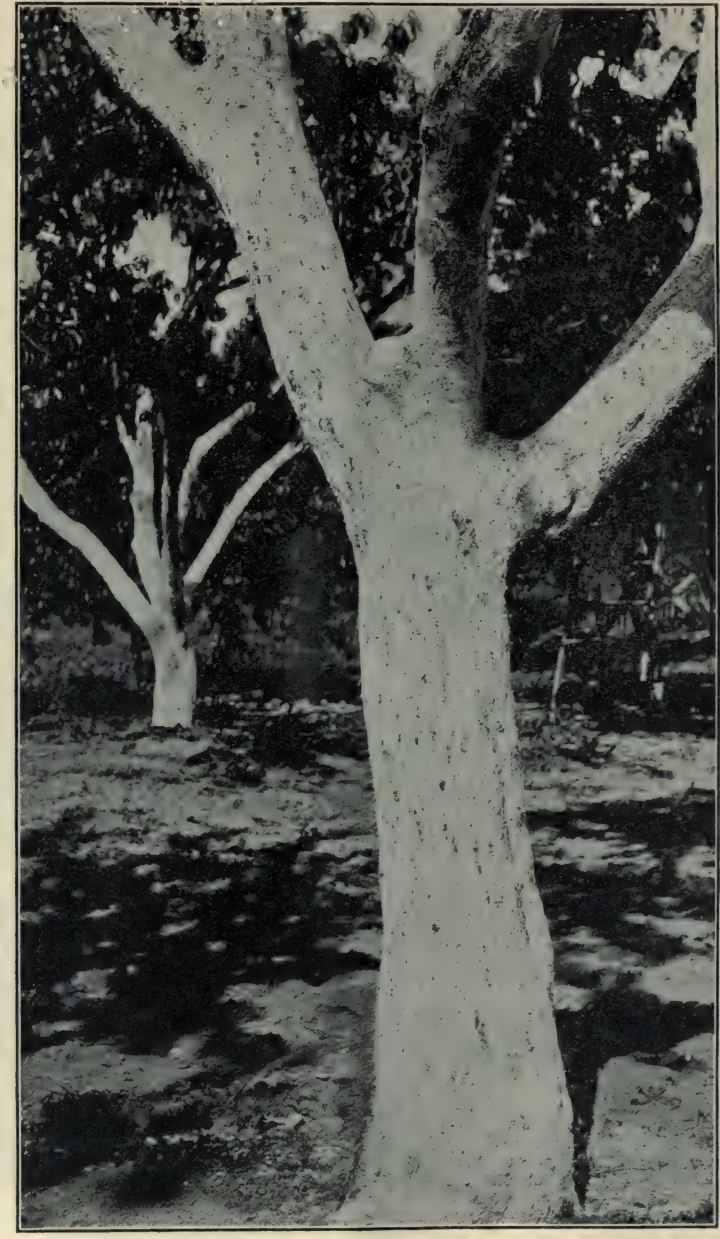

FIG. 13.—Peach trees treated with whitewash to combat the fruit-tree barkbeetle. (Original.)

coats of the whitewash during the season—one early in the spring, another about the middle of summer, and a third in the fall. If the whitewash is mixed thin enough for application with a spray pump, two sprayings made about the same time will be necessary to supply a protective covering to the bark. If the mixture is made thicker, a single coat applied with a broom or brush will be sufficient for one time. The addition of a handful of table salt to each pail of whitewash will render the application more adhesive. Good results have been obtained by mixing a pint of crude cresylic acid with each 10 gallons of the whitewash.

The whitewash will not kill the insects already in the trees, but if a solid coat is maintained on the bark it will prevent in a large measure the laying of additional eggs and enable the trees, by the help of cultivation and fertilizers, to recover from the injury.

Many other washes, paints, and sprays have been tested against these insects, but when the cost of material, simplicity of preparation, and effectiveness are considered, nothing has been found that can be recommended as preferable to whitewash when prepared and used as directed above.

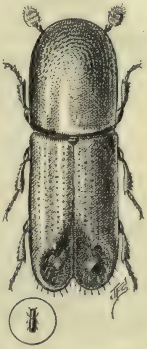

FIG. 14.—The apple wood-stainer (*Monarthrum mali*): Adult, or beetle. Much enlarged—natural size in small circle. (Original.)

THE APPLE WOOD-STAINER.[1]

The small wood-boring beetle known as the apple wood-stainer (fig. 14) derives its name from the fact that it stains the walls of its burrows black by propagating thereon a moldlike fungus on which it and its larvæ feed. This interesting habit is possessed by several related species, and the name "ambrosia beetles" has been given to the group on that account. Frequently the wood surrounding the burrows is stained a dark color as a result of the fungous growth.

The adult apple wood-stainer (fig. 14) is about one-tenth of an inch long and is reddish-brown to nearly black. In form it is cylindrical and slender, and it does not differ greatly in appearance from the barkbeetles described previously. A score or more of food plants have been recorded. These include forest and orchard trees, casks in which wine and other liquids are stored, and manufactured mahogany lumber. Among fruit trees it is known to attack apple, plum, cherry, and orange. About 50 years ago it attracted attention as an enemy of apple trees in Massachusetts, where it is said to have riddled the trunks of many young trees. Associated with this species is found another, *Monarthrum fasciatum* Say (fig. 15) of similar appearance and food habits.

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[1] *Monarthrum mali* Fitch; order Coleoptera, family Ipidae.

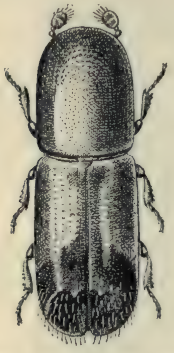

Fig. 15. — *Monarthrum fasciatum:* Adult, or beetle. Much enlarged. (Original.)

The female beetle bores through the bark and into the wood for a short distance and deposits her eggs. Later the short larval galleries are constructed outward from the main gallery made by the parent beetle. (See fig. 16.) Breeding takes place only in diseased, dying, girdled, and felled trees.

The insect is not a common orchard pest, but should it occur at any time in injurious numbers the remedies recommended herein for barkbeetles may be resorted to.

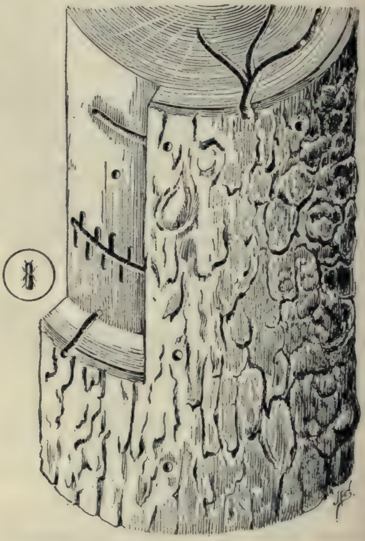

Fig. 16.—Work of the apple wood-stainer (*Monarthrum mali*) in apple wood. Beetle, approximately natural size, at left. (Original.)

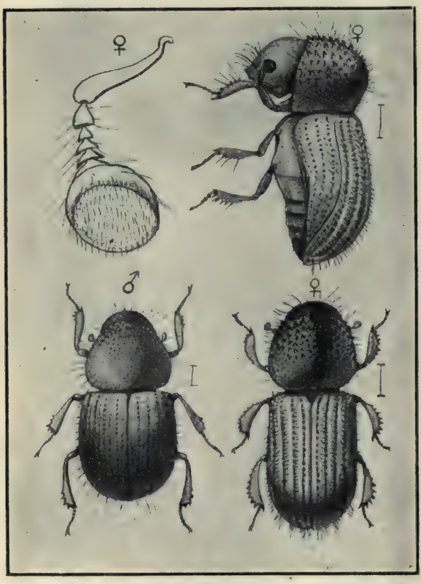

Fig. 17.—The pear-blight beetle (*Anisandrus pyri*): Adults, or beetles, and enlarged view of antenna of female beetle. All much enlarged. (Hubbard.)

THE PEAR-BLIGHT BEETLE.[1]

The pear-blight beetle (fig. 17) has been the cause of occasional injury to fruit trees for many years. It bores into the twigs and branches of apple, pear, peach, and plum trees and causes a dying back of the wood, the injury resembling that of the bacterial disease common on apple and pear, known as pear blight or twig blight. The insect also attacks the trunks of trees and is not confined to orchards, but infests a number of hardwood forest trees, and at least one cone-bearing tree. Like the other species considered in this paper, it prefers to work in diseased and dying wood, although, as has been indicated, healthy trees are sometimes attacked. The species is distributed widely in the eastern part of the United States.

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[1] *Anisandrus pyri* Peck; order Coleoptera, family Ipidae.

The female beetle (fig. 17, upper and lower right) is about one-eighth of an inch in length, of a dark-brown color, and has the head hidden from above by the projecting front of the thorax. The male beetle (see fig. 17, lower left) is only about half as large as the females. The adult female, when attacking twigs, usually makes her entrance at the base of a bud. The burrow (fig. 18) extends to and around the pith and has a number of short side branches running with the grain of the wood. Eggs are deposited loosely in the burrow and the larvæ feed on the ambrosia fungus which is propagated on the walls. The larvæ transform to adults within the burrow made by the parent beetle and issue from the tree through the entrance hole. Small branches are killed by these burrows, but when the beetles enter large branches or the trunks of trees the injury is not serious, and, as has been stated, more often than otherwise only unhealthy wood is entered. Injuries caused by twig blight and by these beetles are sometimes similar in appearance, but there is no relationship between the two troubles, and orchardists should be able to distinguish the insect injury from the blight by a close examination of the twigs.

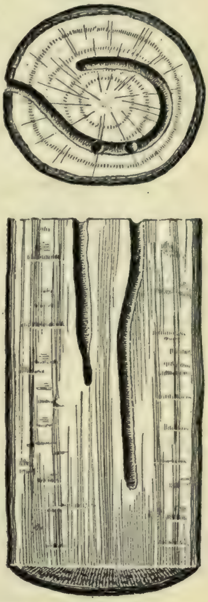

FIG. 18.—Gallery of the pear-blight beetle in poplar twig: Upper figure, transverse section; lower figure, longitudinal section. (Marx.)

Where remedial measures are called for, the methods recommended for use against the other species described herein should be adopted, with the additional precaution of cutting out and burning the infested twigs.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 764 OCTOBER 31, 1916

Contribution from the Office of Markets and Rural Organization, Charles J. Brand, Chief.

COTTON GINNING INFORMATION FOR FARMERS.

By FRED TAYLOR, *Cotton Technologist;* D. C. GRIFFITH, *Investigator in Cotton Marketing;* and C. E. ATKINSON, *Assistant in Cotton Marketing.*

CONTENTS.

	Page.
Separation of seed for planting	1
Ginner's certificate for the farmer	3
Usual ginning process	4
One and two story gins	5
General discussion of the principal parts of gin machinery:	
Elevators	5
Preparatory cleaning processes	8
Cleaner feeders	10
Gin saws and ribs	10
General discussion of the principal parts of gin machinery—Continued.	
A comparison of 10 and 12 inch saws	10
Air-blast and brush gins	14
Presses	15
Gin compresses	16
Plated bales	17
Careless preparation of the American bale of cotton	18
Conclusions	22

SEPARATION OF SEED FOR PLANTING.

One of the greatest difficulties in the production of cotton of uniform fiber is the inability of the planter to maintain the purity of the seed of that particular variety which he prefers. He makes a practice of buying new seed every two or three years, the contention being that seed will "run out" in this length of time; that is, his seed becomes so badly mixed, either at the gin or by cross breeding, that it no longer represents the variety originally planted. In the very nature of things the different varieties of cotton become mixed if grown in adjacent localities. This is caused by the interchange of pollen between different varieties of cotton. Pure seed

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NOTE.—This bulletin contains a general discussion of those mechanical processes of ginning which are of importance to the farmer. Only saw gins are treated, inasmuch as only a small part of the cotton crop is ginned by any other method. The purpose is to bring to the attention of cotton producers, especially in those communities where cooperative handling and marketing of cotton is possible, the many benefits to be obtained by keeping the seed pure and eliminating a portion of the losses due to indifferent preparation of cotton for the market. The publication should be of interest to cotton merchants, factors, ginners, and others of the cotton trade.

for planting purposes may be maintained by a proper system of seed selection,[1] which applies to all varieties of cotton.

It is a good plan to pick planting seed from the lint by hand, in order that it may not become mixed with seed from cotton of another variety, or if so much seed is needed that this is impracticable the cotton may be ginned in the regular way with good results if the ginner will first take the precaution to clean out thoroughly all the gin heads and let the machinery run a few minutes to make sure that all the seed and seed cotton from preceding bales have been removed. Particular care should be exerted to the end that the seed bin and trough are entirely free of any seed that may have been left from some other variety of cotton. In some gins the seed is not allowed to go into the seed bin, but by means of a board or piece of metal is conducted to the floor of the gin house, which should be swept clean before beginning the operation. This is by far the safer method. Some improved gins have a hinged metal chute which may be let down so that the seed discharged from the breasts will fall onto the floor instead of into the seed trough.

If a large amount of selected seed is to be saved, the best results are obtained either by ginning very early in the season or after the rush of the season is over, when the ginner can take greater care in exercising such precautions as will maintain the purity of the seed. It is practically impossible to maintain the purity without the cooperation of the ginner, and it is unreasonable to ask him to delay his regular ginning work and keep other patrons waiting. Many ginners designate a certain day each week or certain days at the end of the season for ginning for planting seed.

This care is necessary for the following reasons:[2] In the usual process of ginning, the seed roll, containing about 30 to 35 pounds of seed, is originally made from the seed of the first bale ginned. This seed roll fills the gin head, but the seed in it changes constantly and gradually. Thus each customer, after the first, receives the right amount of seed, when he catches it in the seed bin, but the amount is not made up entirely of the seed from his own cotton, some of that being left in the seed roll, to make up for that which he received from the roll as originally formed. For any purpose other than for planting this is no detriment, but it can readily be seen that seed obtained in this way may be composed of several varieties.

A most effective method of obviating this very serious defect in present methods can be used to advantage if each community will determine by experiment[1] the particular variety of cotton which is best suited to its section and agree to plant this variety only. With the present practices in ginning and the common custom of planting different varieties indiscriminately in the same locality, it is only a question of time when all varieties, no matter how well selected, will descend to one mongrel type.

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[1] Kearney, Thomas H. Seed Selection of Egyptian Cotton. U. S. Dept. of Agriculture, Bulletin No. 38, 1913.

[2] Saunders, D. A., and Cardon, P. V. Custom Ginning as a Factor in Cottonseed Deterioration. U. S. Dept. of Agriculture, Bulletin No. 288, 1915.

GINNER'S CERTIFICATE FOR THE FARMER.

By driving a wagonload of seed or unginned cotton upon the scales, the gross weight may be determined. When the cotton has been ginned, the empty wagon is weighed. This second weight represents the tare, which is subtracted from the gross weight; the remainder represents the weight of the seed cotton with its impurities of dirt and trash, thus:

	Pounds.
Gross (weight of loaded wagon)	3, 020
Tare (weight of empty wagon)	1, 600
Net (weight of seed cotton)	1, 420

Thus the customer can compare the ginner's weight of seed cotton with his original weight—that is, if he has weighed the cotton into his wagon. He can also calculate how the weight of his bale of cotton compares with the weight based on his estimate of the correct percentage of resulting lint. This percentage varies in different sections, as well as in different varieties of cotton. In sections where the staple is short, when the whole weight of the bale, including bagging and ties, is included, the percentage often runs as high as 36 to 38 per cent and occasionally as high as 45 per cent. It is frequently said that cotton should "third itself"; in other words, 1,500 pounds of seed cotton should make a 500-pound bale. If the cotton "thirds itself," it is a fair average, although it must be borne in mind that climatic conditions, variety, soil, and amount and quality of fertilizers used are among the factors which influence the percentage.

Herewith is given a copy of a weight certificate which is recommended, as it gives all details from the time the wagon is first weighed until cotton and seed are ready for the market:

Driver____________________ Date____________________

On. Off.

JOHN DOE, Ginner.

Owner ____

	Seed cotton.
Seed disposition______________	Gross____________________
Weight of seed______________	Tare____________________
Bale mark and No.___________	Net____________________
Bale weight______________	Weigher__________________

Name of driver should be written on line marked "Driver."

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[1] "Distribution of Cotton Seed in 1915." U. S. Dept. of Agriculture, Bureau of Plant Industry, Document No. 1163.

The words "On" and "Off" are used to show whether the driver was on or off his wagon when the load was weighed. If on, the word "Off" should be crossed out; if off, the word "On" should be crossed out. A weigher can not be expected to remember whether the driver was on or off the wagon when the load was weighed, and it is necessary to weigh the wagon the same way the second time in order to have the correct weight of seed cotton.

If seed is hauled from the gin by the customer the word "Out" should be written in the "Seed disposition" line. If seed is stored with ginner, "In" or "Stored" should be used. If sold to ginner, this space should be marked "Sold," followed by number of his check given in payment.

The line marked "Gross" shows the weight of the wagon and load. The line marked "Tare" shows the weight of the wagon after unloading the seed cotton. Subtracting the tare from the gross, the net weight of seed cotton is given, which should be inserted on the line marked "Net."

All other lines should be filled in as indicated.

The original of this certificate is made with perforated edge that it may be torn out and given to the customer. A duplicate certificate of a different color should be left in the book. Carbon sheets should be used in order that an exact copy may be kept by the ginner for his records, as an error is likely to occur if the duplicate is made in some other way. The use of carbon sheets will save labor and possible misunderstandings.

If the customer returns for the seed or sells it, after it has been left in storage, the ginner should make proper notation on the original and duplicate certificates.

USUAL GINNING PROCESS.

In the usual ginning process the seed cotton is fed into chutes by the elevator system, which takes the cotton out of the wagon by means of a suction fan. The cotton drops through the chute into the feeder, and is then fed evenly to the gin saws, where the lint is separated from the seed.

The seed slides down to a trough from which, by a screw conveyor, it is carried to the seed pipe, thence to the seed bin or seed house. The transfer through the seed pipe to bin or seed house is effected either by a revolving screw conveyor or by the exhaust from the fan which furnishes the suction for unloading the cotton. When the screw conveyor is used, in the more up-to-date plants, the bottom of the seed trough is made of perforated metal which permits sand and dirt to be sifted out, thus improving the quality of the seed. If the customer desires to retain his seed, he asks to have it conveyed into the seed bin, from which he takes it after his bale is ginned. When he desires to sell or store it, it is conveyed into the seed house. The seed bin is situated in the gin yard between the ginhouse and the seed house, as with this arrangement the seed may be stopped at the seed bin or conveyed to the seed house by the use of valves in the seed pipe. When the seed is sold to the ginner or stored with him, it is not usually weighed, but a certain number of pounds are allowed. This amount usually ranges from 60 to 66 pounds per 100 pounds of seed cotton, the allowance being based on the average quantity of seed to 100 pounds of seed cotton in a given locality. The system of average percentages is, at best, inaccurate and unsatisfactory. An automatic weighing device is manufactured which can be set to weigh any small amount of seed, the weight of a bushel being the usual amount. An automatic trip lets the seed into the seed pipe and registers the quantity on an indicator, which makes it possible for the ginner to pay each customer for his exact weight of seed. The trips of this indicator are carried forward automatically to another indicator which keeps the total number of trips through the season, and in this way affords the ginner an easy method of knowing the amount of seed he has on hand. The first indicator is reset for each bale.

The lint cotton is passed from the gin saws through the lint flue to the condenser, which gives it a final cleaning, smooths it out into a bat or sheet, and drops it in regular layers into the press box,[1] where it is pressed, wrapped, and tied, the size of the bale being usually 27 by 54 by 45 inches.[2] The bale is weighed, a certificate being given to each customer, and it is then ready for market.

ONE AND TWO STORY GINS.

Gins as commonly built are either of one or two stories. There are some advantages to each plan. Without doubt a gin can be operated on the ground floor with less vibration, and therefore with less wear, tear, and friction; however, with proper care and material a two-story gin can be built that will not vibrate to a great extent. Low fire risk, and therefore cheaper insurance, is one of the chief advantages of one-story gins with an earth or concrete floor. (See figs. 1 and 2.)

GENERAL DISCUSSION OF THE PRINCIPAL PARTS OF GIN MACHINERY.

ELEVATORS.

There are two distinct types of elevators used on modern gins, the pneumatic elevator and the belt-distributor elevator.

The pneumatic elevator consists of two wooden or metallic pipes passing over a single gin or battery of gins. (See fig. 3.) One is the air pipe, the other the cotton pipe. These pipes open at the bottom into chutes over the feeders. The cotton passage is separated from the air passage by a heavy wire screen. The suction in the air pipe causes the seed cotton to pass along the cotton pipe and drop into the chutes. When the chutes above the feeder become full, the cotton ceases to pass through the cotton pipe until a portion of the seed cotton is ginned out. When the air pressure is removed at regular intervals, the cotton is dropped to the feeders, then to the gin saws. The method of removing the air pressure varies with different makes of elevators. (Fig. 3.)

---

[1] A double press box is the one in most general use. When a bale is ginned into it the press box is revolved through an arc of 180° to be pressed.

[2] Twenty-seven by 54 inches is the standard size of the press box. The depth depends upon the density to which the bale is pressed, 45 inches being the usual dimension.

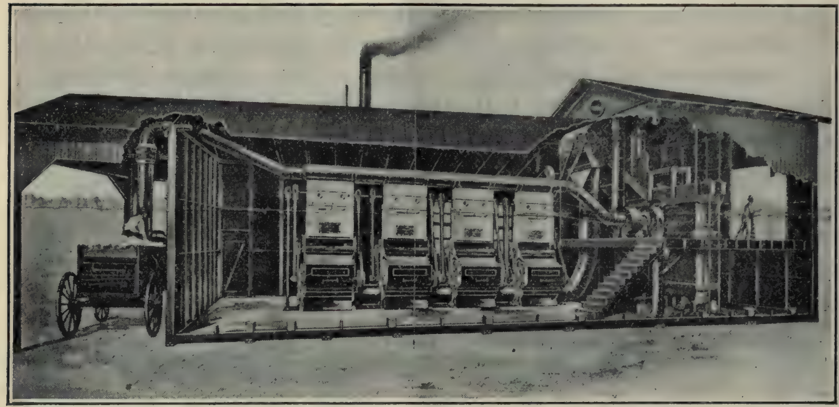


FIG. 1.—One-story gin, showing battery of four gin stands on the ground floor.

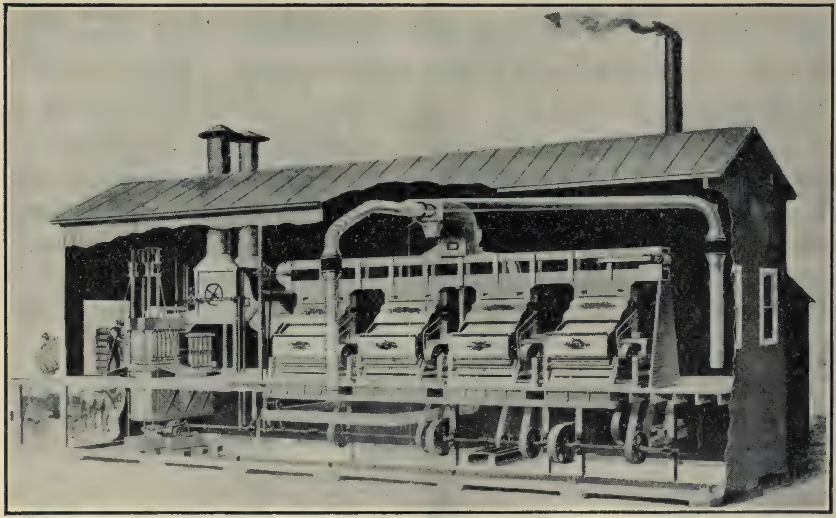


FIG. 2.—Two-story gin, with battery of four gin stands on second floor.

The belt-distributor elevator consists of what is called a separator placed over a belt box through which passes a belt with projections or fingers placed thereon. (See fig. 4.) A suction fan connected with the separator draws the cotton from the wagon into the separator, where it is thrown against a heavy wire screen, after which it is carried to the feeders by the belt distributor. When the feeders are filled, the surplus cotton is carried by the belt distributor to the end of the belt box and dropped onto the floor. This surplus cotton is called the "overflow."

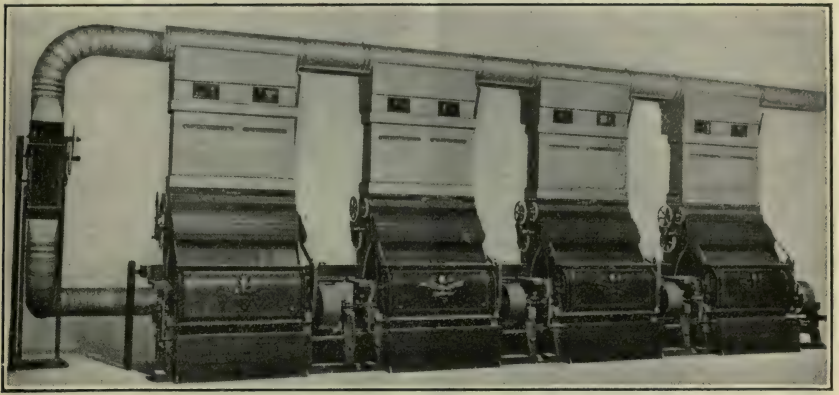


FIG. 3.—Pneumatic elevator over a battery of four gin stands.

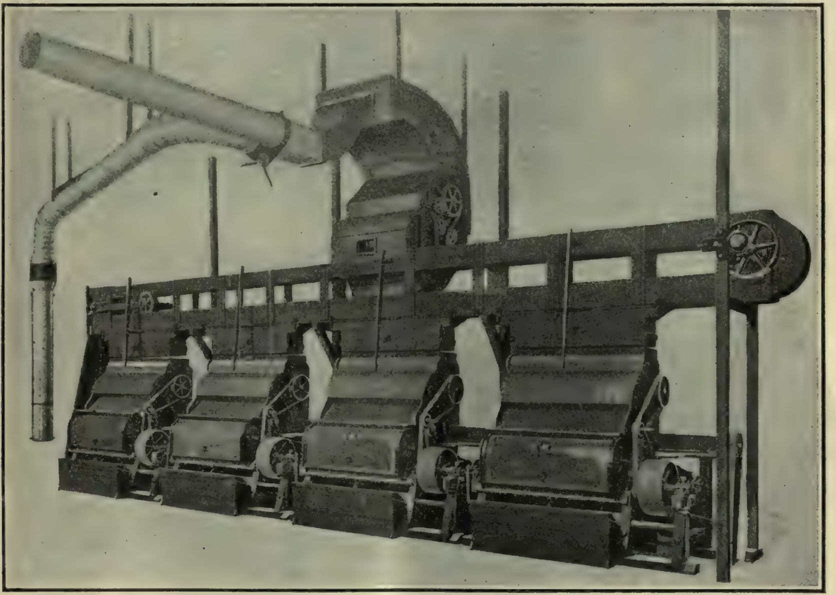
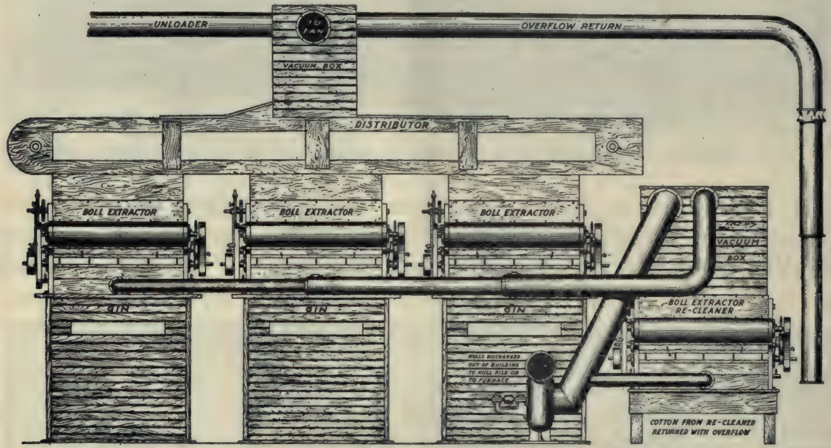


FIG. 4.—Belt-distributor elevator over a battery of four gin stands.

A large portion of the cotton going through the belt-distributor elevator goes to the overflow, and when the cotton on the wagon is exhausted the suction is switched and the cotton from the overflow again passes through the separator and belt distributor. In this way it receives a double beating and cleaning before it goes to the feeder. It is a noticeable fact that the portion of the cotton which goes to the overflow and is again passed through the cleaning system is always of a better grade than that which passes through the machinery only one time. When ginning his own cotton, a ginner frequently passes the entire load through to the overflow and then rehandles the seed cotton before ginning. There is no doubt that it is profitable to do this, as the quality is thereby improved to some extent.


UNLOADER
TO FAN
OVERFLOW RETURN
VACUUM BOX
DISTRIBUTOR
BOLL EXTRACTOR
BOLL EXTRACTOR
BOLL EXTRACTOR
VACUUM BOX
GIN
GIN
GIN
BOLL EXTRACTOR RE-CLEANER
HULLS DISCHARGED OUT OF BUILDING TO HULL PILE OR TO FURNACE
COTTON FROM RE-CLEANER RETURNED WITH OVERFLOW

Patented: July 2, 1912, No. [illegible] December 16, 1913, No. [illegible] December 16, 1913, No. 1081461 February 23, 1915, No. 1128230 Others Pending.

FIG. 5.—Cleaning process attached to gins, showing boll extractors acting as feeders.

PREPARATORY CLEANING PROCESSES.

There are a number of bolly machines, boll extractors, boll breakers, beaters, cleaners, etc., which have for their object the separating of boll hulls, trash, and other foreign matter from the seed cotton before it reaches the gin saws. Some of these machines are separate devices through which the seed cotton is passed before reaching the feeders; others are built as a part of a cleaner feeder; and still others are combined with the separator. Frequently one gin plant may make use of several of these devices, passing the seed cotton through each in turn. Figures 5, 6, 7, 8, and 8A illustrate a number of the different kinds of machines.

These devices greatly improve the preparation of both cotton and cotton seed for the market. The boll hulls thus removed may be used for fuel, thus sometimes effecting a considerable saving.

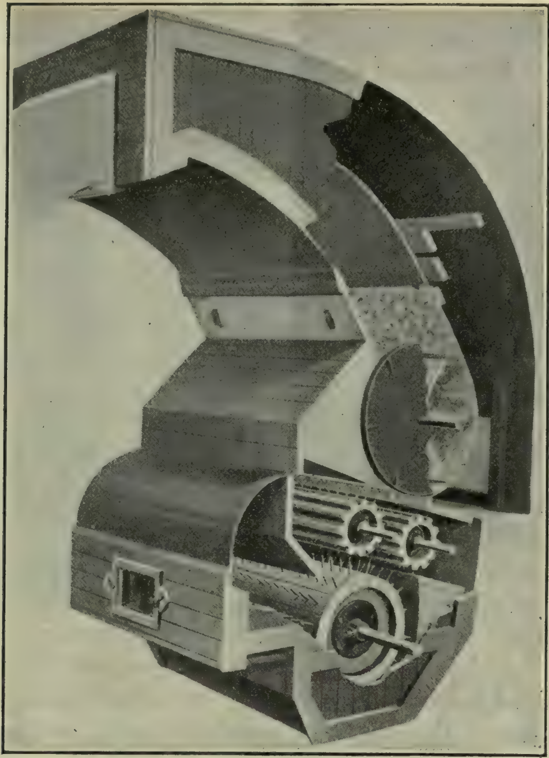


FIG. 6.—Combined cleaner and separator.

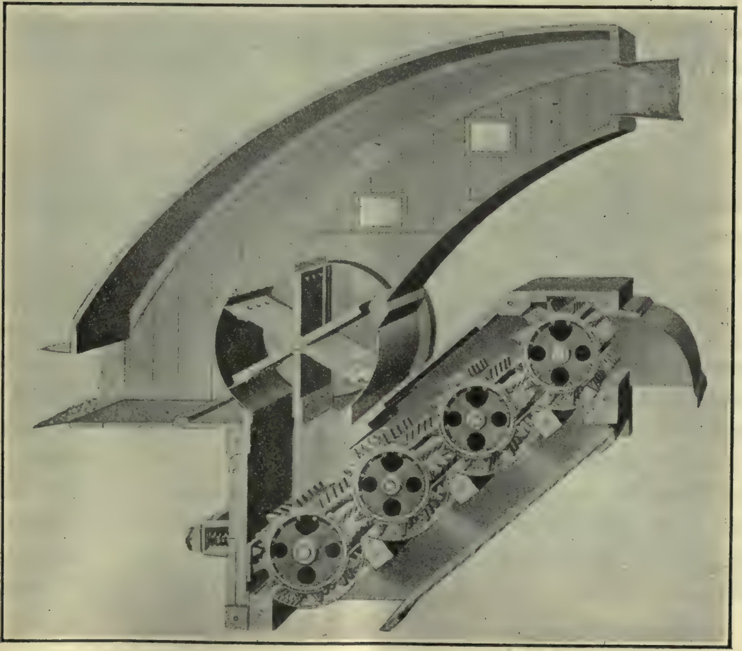


FIG. 7.—Combined cleaner and separator.

CLEANER FEEDERS.

Cleaner feeders are sold by every firm which manufactures cotton gins, the different makes being practically the same in mechanical principle. Cleaner feeders should be used by all ginners in preference to plain feeders without cleaner attachment, as by their use the quality of the cotton is improved materially. In the cleaner feeder the cotton passes through fluted rollers, and over a rapidly revolving picker roller which is studded with spikes, thus beating the cotton vigorously and dragging it across a heavy wire screen. The greater portion of the dirt and dust drops through this screen and is carried out by a screw conveyor. Figures 9 and 10 show working parts of one style of cleaner feeder, and figure 11 a cross section of another style.

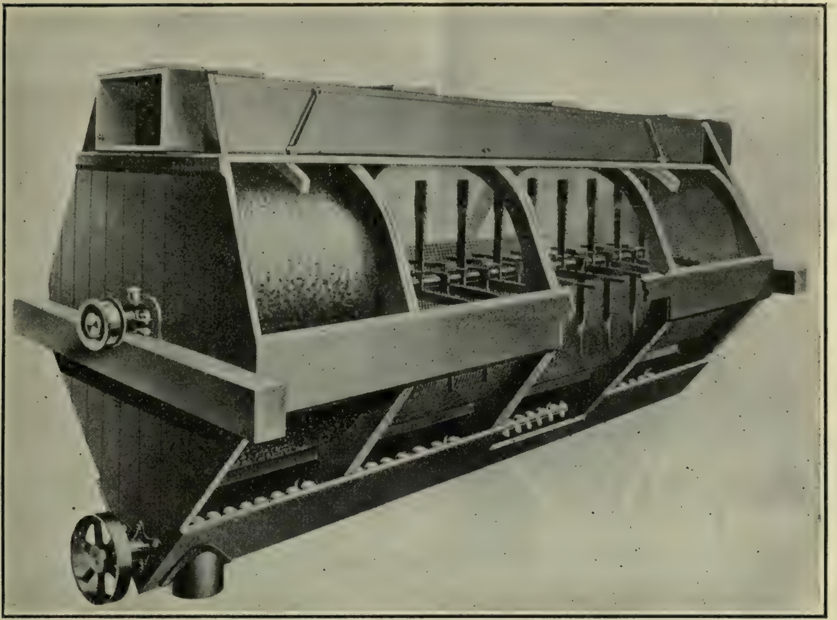
GIN SAWS AND RIBS.

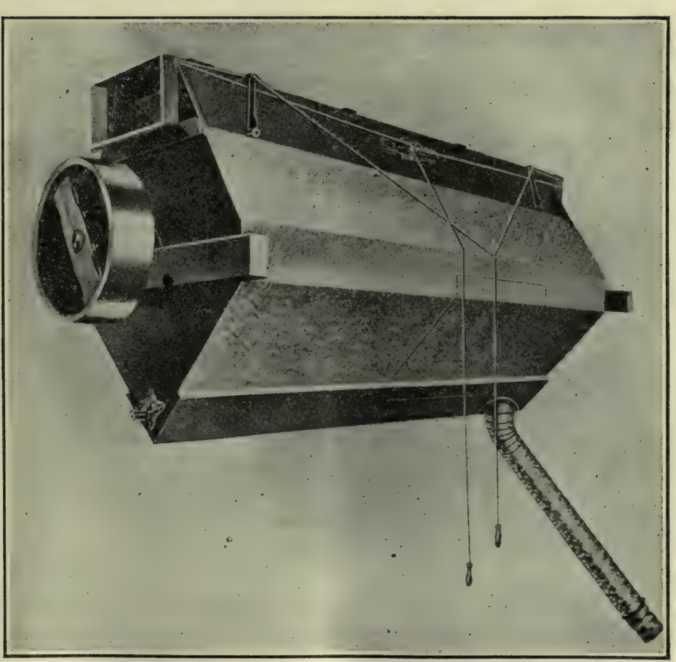
Gin saws may be either 10 or 12 inches in diameter. Ten-inch saws have been in use for a long time, while the 12-inch saw has recently begun to gain in popularity.

The designs of the ribs of gins are different for plain, single-rib huller and double-rib huller breasts. Huller breasts have been used more commonly in those sections in which cotton is "gathered" rather than "picked." When cotton is "gathered," bolls, leaf, and trash are mixed with the seed cotton. A huller breast is required to eliminate these bolls, which otherwise would be broken up and remain in the lint. Even in those sections where cotton is picked clean, the opinion is becoming prevalent that a huller breast is a good investment, as years in which the rotting of the bolls causes cotton of lower quality than usual come at uncertain intervals to every section and in such years a huller breast is needed.

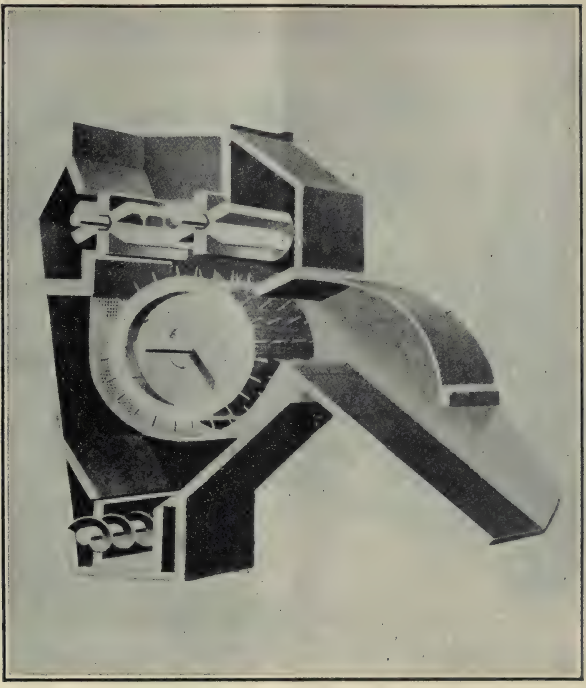
A COMPARISON OF 10 AND 12 INCH SAWS.

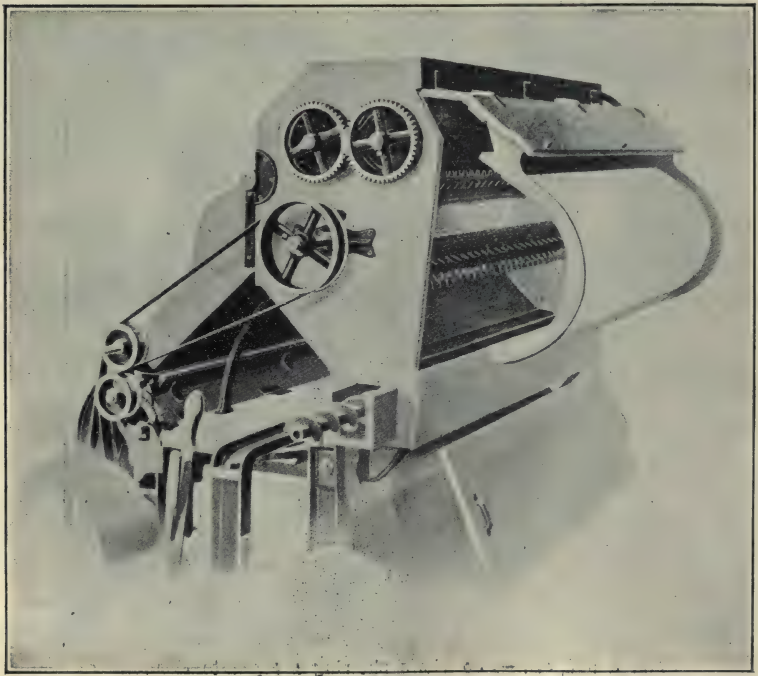
The use of 12-inch saws on plain gins is comparatively new, although they have been used for years on huller gins. The cutting edge of a 12-inch saw is 6.28 inches, or 20 per cent greater than that of a 10-inch saw; the strength of the saw is not appreciably impaired by giving it this greater diameter. The life of a 12-inch saw is longer than that of the 10-inch, as it will gin the same number of bales with less use of each tooth and, therefore, will not have to be sharpened so often. Sharpening a gin saw not only wears down the cutting surface but is an expensive operation, inasmuch as it takes time in the ginning season when all the saw cylinders should be at work. With some outfits, however, an extra saw cylinder is kept, which is interchangeable, and should always be sharp and ready to take the place of some cylinder that may need replacing.





FIGS. 8 and 8A.—Two views showing a separate cleaner.





FIGS. 9 and 10.—Two views showing working parts of one style of cleaner feeder.

In this case the only expense to the ginner is the time taken in changing cylinders and sharpening the saws. The sharpening of saws at intervals during the ginning season is necessary, otherwise they will become so dull as to interfere with the thoroughness of their work. When a saw is sharpened, the throat as well as the point of the tooth acquires a very rough, jagged edge, which damages the fiber of the cotton until it is worn smooth. This smoothness is not obtained until several bales have been ginned. Therefore, any method or device which will reduce the necessity for sharpening a saw tooth will reduce to that extent the damage from this cause.

The question as to the speed at which gin saws should be operated is often discussed. For ginning cottons up to and including $1\frac{1}{16}$ inches in length of staple, under average conditions, a speed of about 400 revolutions per minute for 10-inch saws and 333 for 12-inch saws is recommended. The capacities of gins equipped with saws of these two diameters are approximately equal at these speeds. The surface speed of the saw tooth as it passes through the seed roll determines not only the capacity of the gin but the condition of the ginned fiber. The entire American crop of cotton of approximately 15,000,000 bales has to be ginned within practically four months. Some gins are operated day and night at their full capacity. Often gins are "speeded up" in an effort to gain time, but the unfortunate result of speeding is to cut the fiber of the cotton to an extent which costs the producers a great amount of money each year.

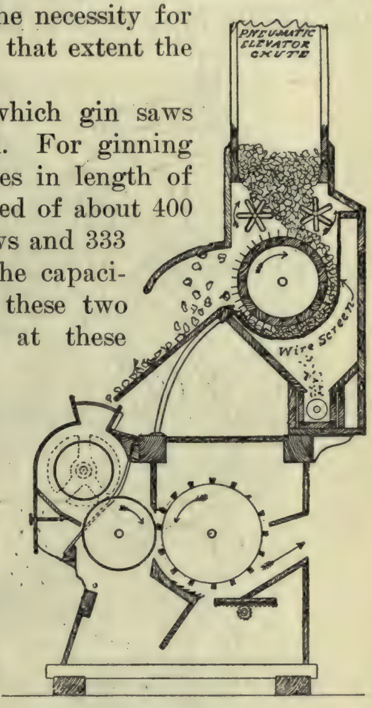


FIG. 11.—Cross section, showing one style of cleaner feeder.

While the undue speeding of gins is discouraged, because of the injury to the fiber, it is realized that a large amount of education will be necessary to overcome the practice. Speeding of gin machinery is not a good economic principle from a ginner's standpoint. When a piece of machinery is run at a greater speed than was intended by the manufacturer, parts break, boxes run hot, belts slip, and any number of other accidents may happen which, through delays for repairs, will more than offset any advantage gained by a greater speed. The use of 12-inch saws and a reduction in speeds should result in a general improvement in the mechanical operation of the whole ginning plant.

With the saw shafts running at the same speed, the gin equipped with 12-inch saws will have 20 per cent advantage in capacity over the same gin equipped with 10-inch saws. It is seen that this advantage is obtained with no excessive speed of any part of the machinery, with very little extra burden on engine and belts, and with no appreciable increase of running expenses. Under no circumstances, however, should a ginner work an injury to his customer and to the cotton trade in general by sacrificing the value of the fiber of the cotton in an effort to increase the capacity of his gin. These suggestions are offered because it is realized that every reasonable method should be used for increasing capacities without damaging the fiber and that greater speeds are permissible under extraordinary conditions such as might exist following a long, dry summer or open autumn.

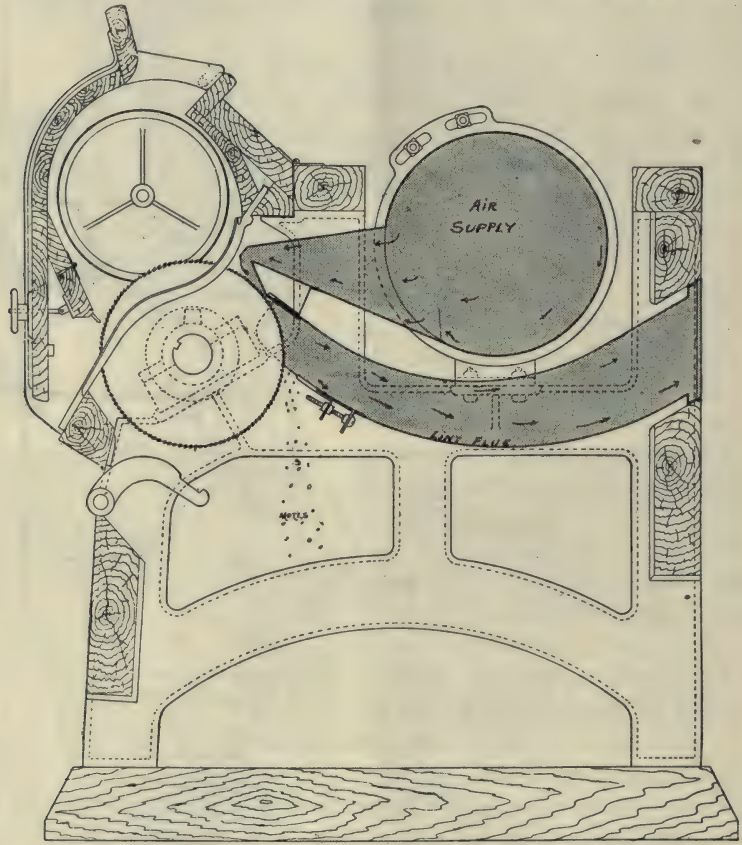


FIG. 12.—Air-blast method of removing lint cotton from gin saw.

AIR-BLAST AND BRUSH GINS.

The lint is removed from the saws by two methods, the air blast and the brush. The air blast is a comparatively new departure in gin manufacturing. The essential difference between the two types of gins is in the method of taking the cotton lint from the teeth of the saws. It has been claimed by some operators of the air-blast system that, in effect, the same principle is used by both methods, the mechanical construction being entirely different. In the air-blast method a fan is used to force a steady stream of air through an opening above the gin saws, directly past these saws into the lint flues, the stream of air having the same general effect as a brush. (See fig. 12.) The brush operates at a surface speed of about three times that of the saw tooth. Some contend that the speed of the brush bends the bristles back so that they just miss the gin saws; others maintain that the bristles touch the saws and exert both an air pressure and an actual contact which takes the cotton away. (See fig. 13.) At all events, the results of the two systems are practically the same, and experts differ as to which is the better method.

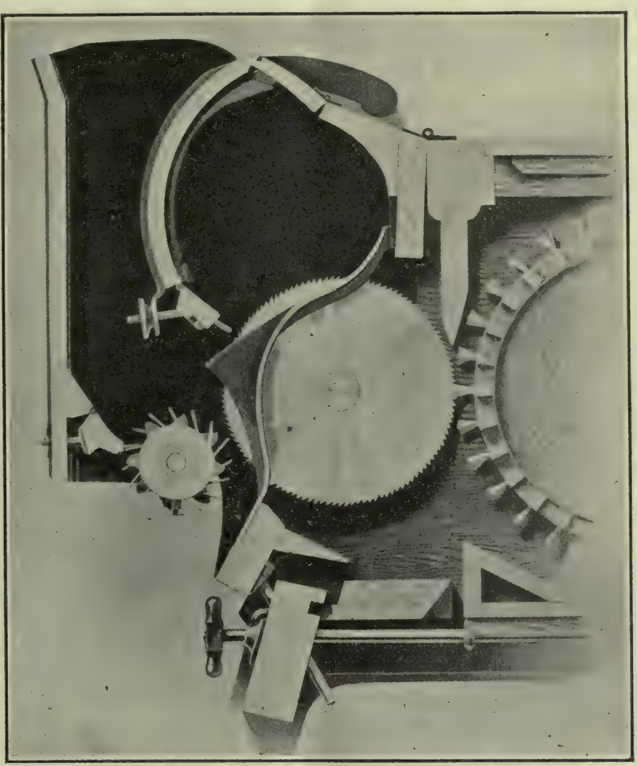


FIG. 13.—Brush method of removing lint cotton from gin saws. Note brush placed in contact with gin saw.

PRESSES.

There are three methods of baling cotton—the screw press, the steam press, and the hydraulic press. The screw press is the one most frequently used, as it does the work well and is cheaper to install than either of the other two. It is very slow, but is fast enough to take care of the cotton turned out by as many as five gins in one battery, as it is possible to "press and tie" a bale when the screw press is used as quickly as the following bale is ginned. However, it would seem that the saving of time by a quicker method would be profitable by saving a considerable part of one attendant's time. The steam press is very quick, and if it were not for the enormous amount of steam consumed and consequent extra cost, it would be an ideal press. It is the most expensive kind to operate, and requires a larger initial investment. The hydraulic press is the most powerful of all, and while requiring a hydraulic pump to operate, the consumption of power is not great, and a burden is removed from the engine as compared with the screw press. While it is not so quick as the steam press, it is desirable from other points of view.

GIN COMPRESSES.

The mechanical construction of a gin compress is in principle simply a very heavy reproduction of the ordinary hydraulic press. This form of compress is capable of producing a density equal to that of a railroad compress, and has been advocated especially for those cooperative organizations of farmers which bale their cotton for direct marketing, shipments being made direct to the domestic mills or for export, eliminating thereby the extra freight, compression, and handling charges accruing on the common flat bale.

It is the usual custom to compress cotton at concentration points, where the bale is "patched"; that is, extra pieces of bagging are put on, ostensibly to cover sample holes, but really to add weight. On arrival at the compress a bale of cotton usually does not have the full amount of "tare" (weight of bagging and ties) permitted by the practices of the cotton trade, and this fact is considered in determining the price. The patches are of sufficient weight to bring the tare up to the maximum limit. Heavier bagging might be used at the gin, and the extra weight thus gained would benefit the producer. A more economical way, however, would be to reduce the limit of tare to approximately 25 pounds per bale, and then a better price, based on the actual weight, might be obtained by producers.

Cotton that is compressed at the gin requires less material for covering, and the bale is wrapped completely, thus preventing some waste which occurs from flat bales; it is also more fully protected from the ravages of weather and fire. Bales compressed at the gin arrive at their destination in better condition than do other compressed bales, as more care is taken in wrapping and tying them. Owing to the enormous amount of cotton which it is necessary to handle in a short period of time at the large compresses, the bales are compressed very rapidly. The natural result is that some of the bands are tied shorter than others. When the pressure is relieved from the bale it expands slightly, exerting a pressure on the shorter ties which sometimes breaks either the ties or the buckles, or the ties are improperly fastened and fall off. It is not uncommon to see a compressed bale arrive at its destination with two or sometimes three ties missing, as is shown in figure 23. Figure 22 shows gin-compressed bales, and attention is directed to the neat and uniform package as compared with the common flat and compressed bale shown in figure 21.

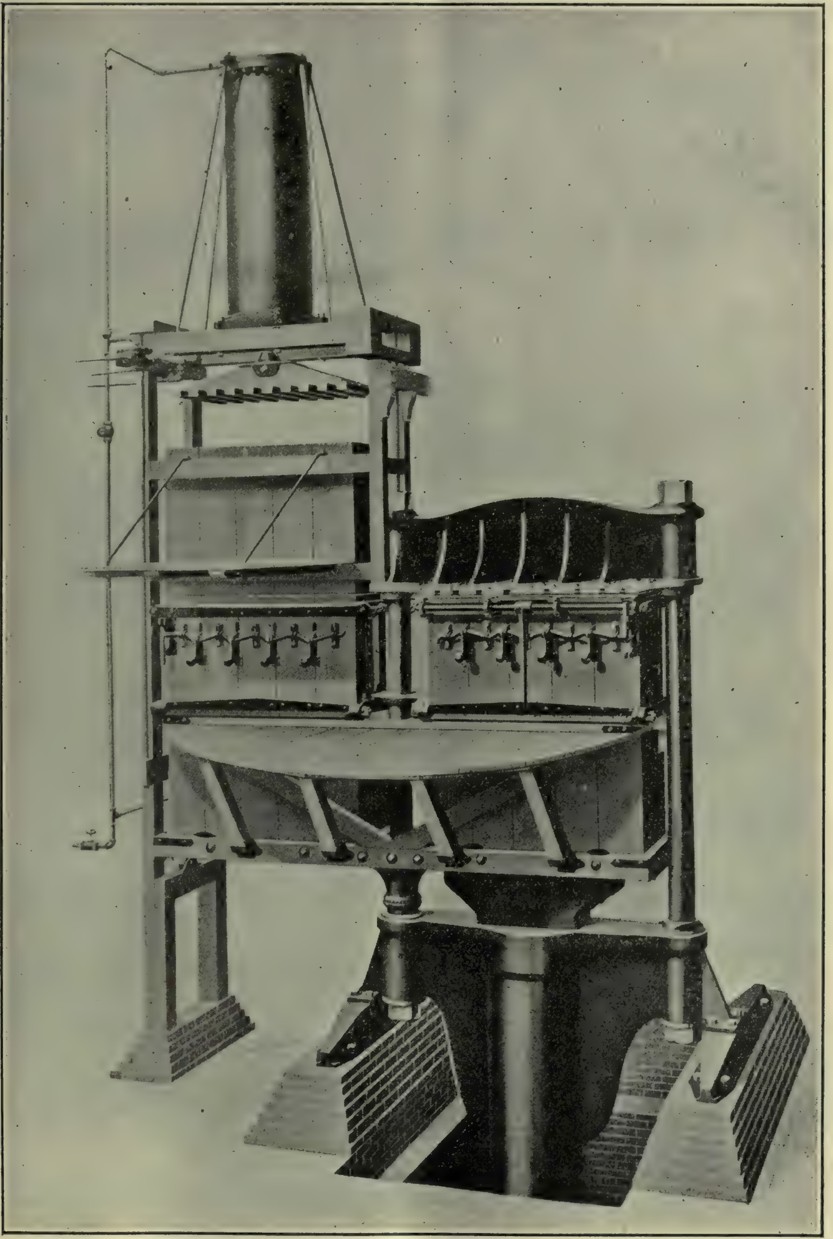


FIG. 14.—A type of gin compress.

Instead of making the bale of the regular dimensions (27 by 54 by 45 inches), a gin compress reduces the bale to approximately the same dimensions as those of a compressed bale (27 by 54 by 23 inches). The press boxes of gin compresses vary in size between 27 by 54 and 24 by 48 inches. The standard bale is 27 by 54 inches and can be compressed to any density up to about 40 pounds per cubic foot. This standard of dimensions is prescribed by all steamship lines, bales of greater dimensions being penalized $1 each.

It is because of these advantages that the installation of gin compresses is urged where cooperative organizations exist and where the ginning and compression of a sufficient number of bales can be controlled. A study of the advantages of gin compression is well worth the time expended by any group of farmers who have for their object the cooperative handling and marketing of cotton. Figures 14 and 15 show two different styles of gin compresses.

PLATED BALES.

One of the most costly results of overcrowded gins is the "plated" bale. The ginner, in his anxiety to crowd the capacity of his gin, frequently does not allow a sufficient length of time for each wagonload of seed cotton to be ginned completely. He does not raise the breasts, and scarcely stops the feed long enough to judge accurately where one bale ends and a new bale begins. His estimate is sufficiently correct, as far as the actual amount of cotton is concerned, but there is a possibility that each bale will get a few pounds of lint from the preceding load, and in turn will leave a like amount of cotton for the next bale. Thus the bales are not only plated, but, as they often are not of the same grade, the better bale may be penalized down to the value of the grade found on its lower side, as the grade of a bale is usually determined by the lower side.

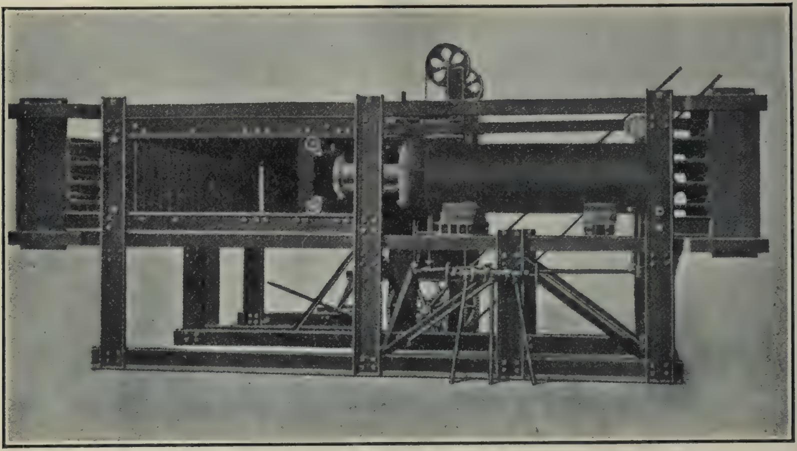


FIG. 15.—A type of gin compress.

CARELESS PREPARATION OF THE AMERICAN BALE OF COTTON.

After cotton is ginned and baled it is often thrown into the gin yard or cotton yard, or perhaps hauled home and left exposed to the weather. The cotton sometimes becomes weather-beaten 2 or 3 inches deep on each edge. In order to ascertain the true grade, it is necessary to cut through this plate when the bale is sold. The bands have to be loosened and the outside plates taken off, or the price per pound paid for the whole bale will be influenced by the lower value of the outside plate. In either case an unnecessary loss is sustained. The better protected the cotton has been the easier it is to find a market, and the higher price it should bring. Cotton which has been picked carefully and stored while dry always finds a ready market in normal times, while no one cares to buy weather-beaten or damaged cotton unless it be penalized heavily. It is a well-known fact that buyers must have a larger margin of profit on weather-beaten and damaged cotton on account of the greater risk incurred, as they are not always able to estimate the extent to which it has been damaged and the chances to resell it quickly are not so good, as there is not always a ready market for cotton of this character.

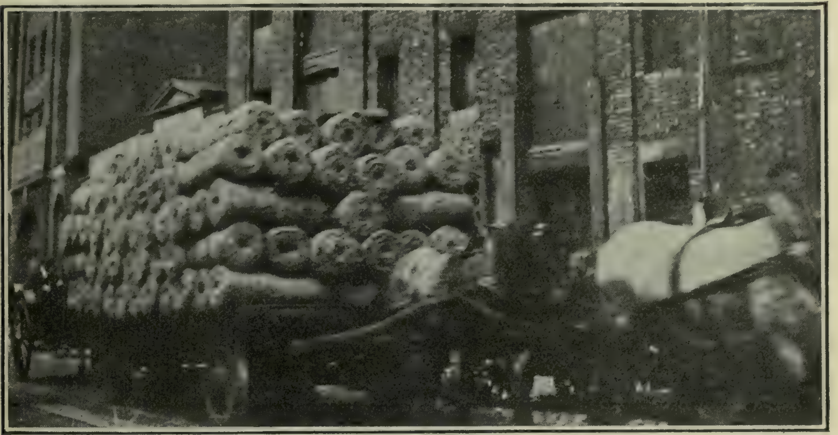


Fig. 16.—Rewoven bagging manufactured from the second-hand bagging taken from American cotton. This lot is in transit from warehouse in Manchester, England, to steamer, for shipment to Southern States, to be used again in wrapping American cotton. The use of this inferior bagging causes much waste that could be avoided by the use of better and more suitable covering.

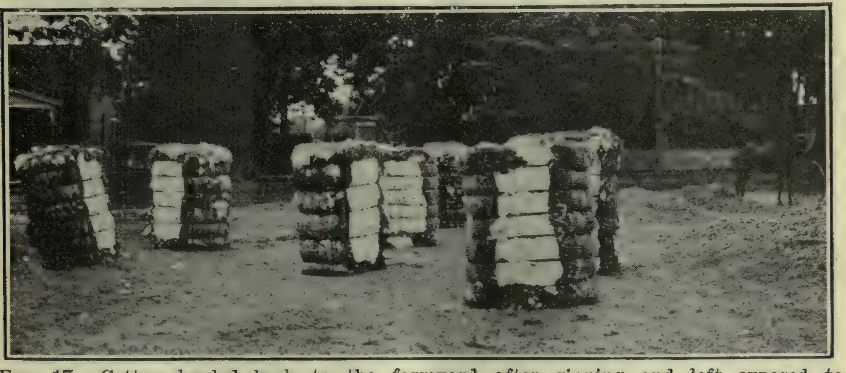


Fig. 17.—Cotton hauled back to the farmyard after ginning and left exposed to weather. The approximate value is $60 per bale. This cotton may deteriorate $5 per bale in value by becoming weather-beaten on the outside of the bale. This form of neglect is responsible for a great proportion of so-called country damage.

There is no agricultural product that is so neglected as American cotton. The careless wrapping, the sampling abuses, indifferent

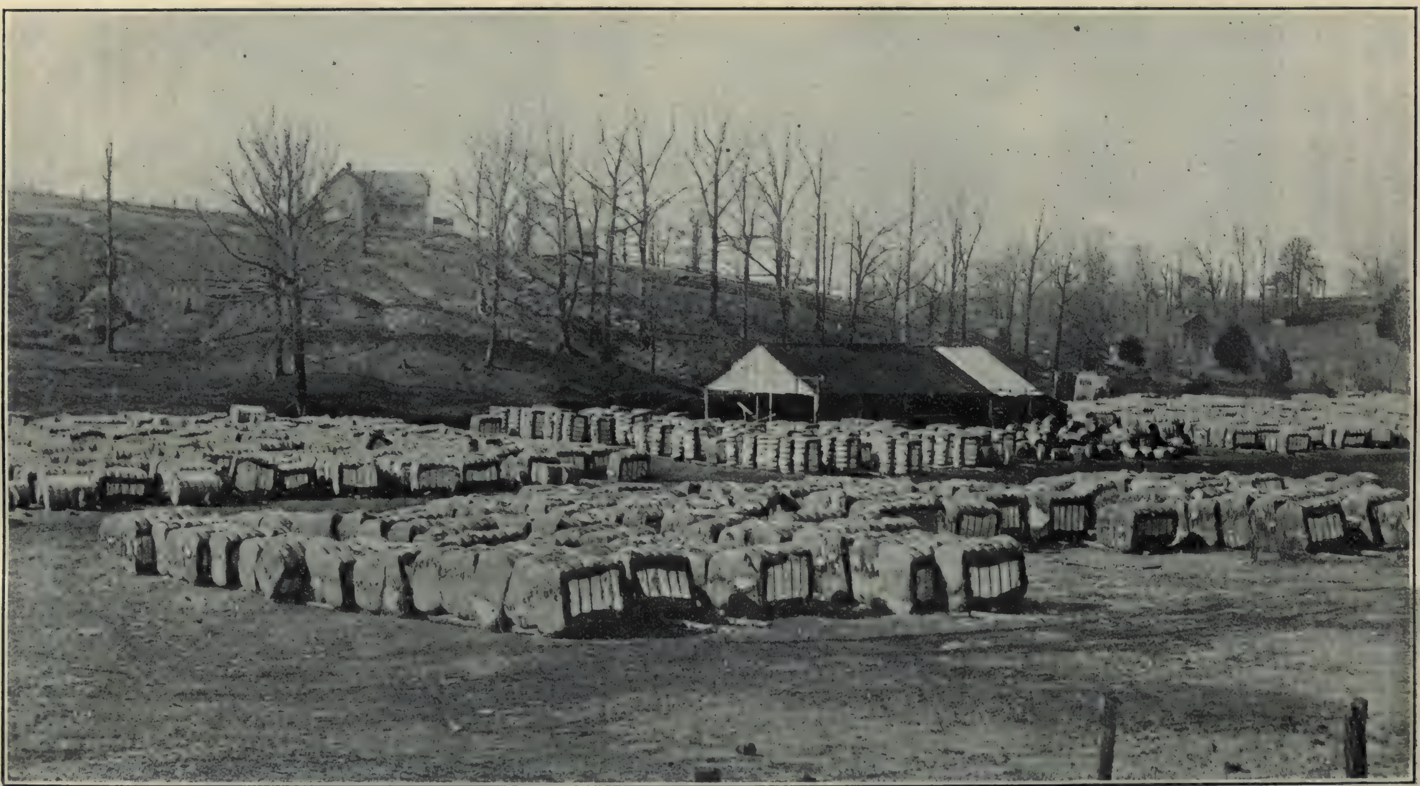


FIG. 18.—Cotton yard, showing cotton resting on wooden poles. Practically every bale in this yard would be saturated with water following a heavy rain. Often these poles become moldy and rotten, causing decomposition of the cotton and resulting in considerable damage, depending upon the length of time cotton is left in this condition. Cotton "stored" in this way is turned occasionally, thus causing the other side of the bale to deteriorate in the same way. Cotton growers suffer much loss through this method of storing.

storage, and country damage all combine to illustrate in a most striking manner the utter disregard of consequences and the careless indifference which exist in the handling and marketing of this important and valuable crop. In no other case does a farmer care for his product from the time it is planted in the spring until it is harvested in the autumn and then expose it to all kinds of weather and abuse. A comparison of the results of the present method of handling the American cotton crop with the results obtained in the case of the Egyptian and Indian crops is best shown by figures 16 to 25, inclusive.

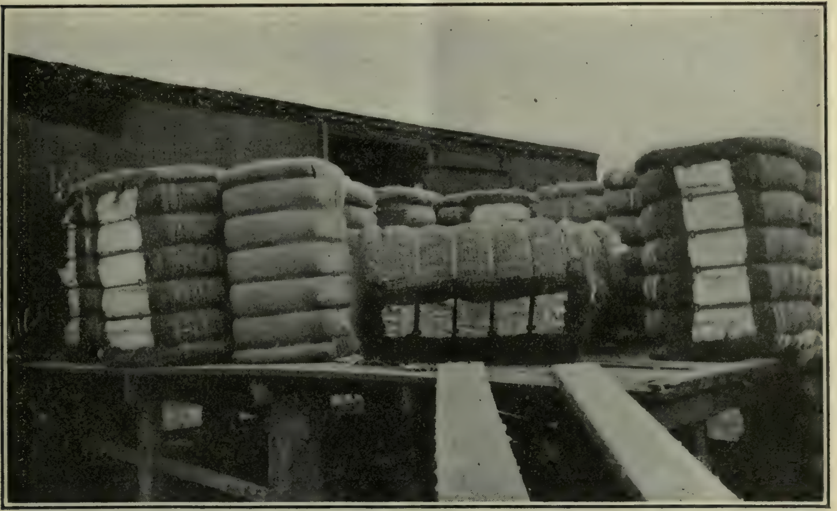


FIG. 19.—Railroad platform, showing uncompressed cotton ready for loading on freight car to be shipped to the compress.

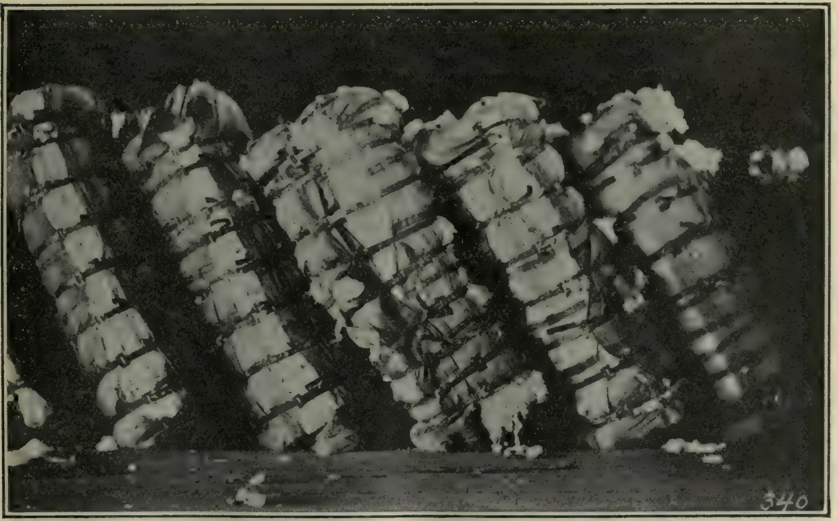


FIG. 20.—Appearance of American bales after being compressed.

CONCLUSIONS.

It is apparent from the discussion of the present mechanical construction of gins that it is almost impossible to maintain the purity of each grower's seed on account of the added expense to the ginner

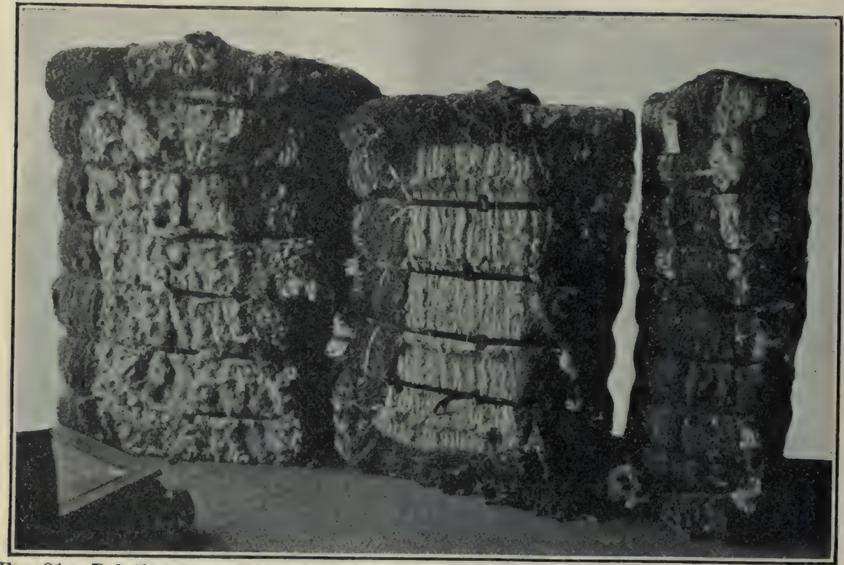


FIG. 21.—Relative sizes of American flat and compressed bales. The two bales at the left show two sizes of American flat bales. The one at the extreme left is not only a much larger bale, but longer than standard regulations. This illustrates the irregularity in the size of the American bale. The picture at the extreme right shows the American bale after it has been compressed. It is ready for shipment to domestic mill or export.

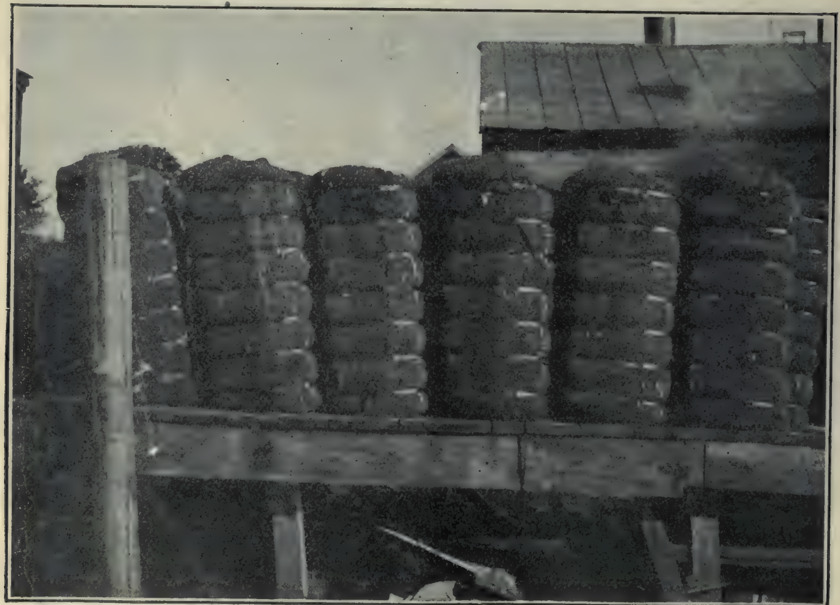


FIG. 22.—Gin-compressed bales on railroad platform ready for direct shipment to domestic mill or port. Note the neat, well-wrapped, and uniform package.

in bringing about such conditions as will insure the accurate separation of seed that is to be used for planting purposes from seed of other varieties of cotton. It is to be hoped that the gin manufacturers will develop some device which will insure a quick and accurate method of keeping separate the seed ginned from each wagonload of seed cotton.

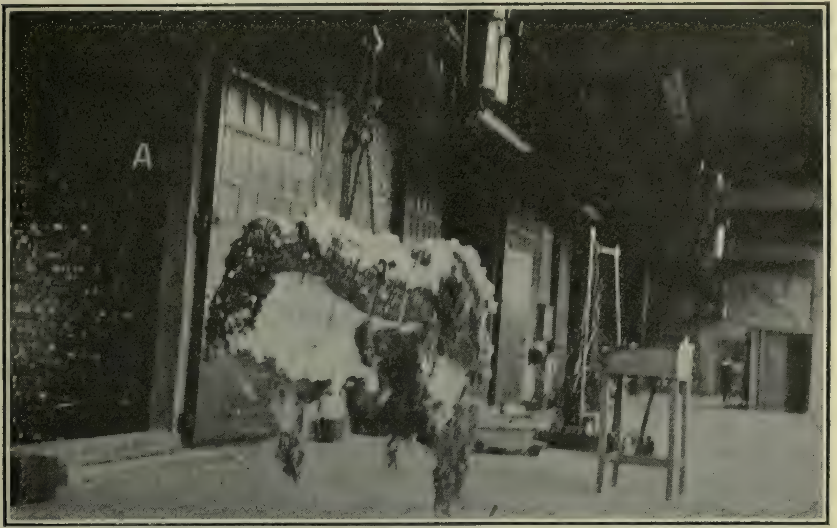


FIG. 23.—Dilapidated appearance of American cotton upon arrival at Manchester, England.

Attention is called to the facsimile of the ginner's certificate discussed on page 3. The use of this certificate, with its duplicate, will not only insure an accurate record of every transaction at the gin and prevent errors in transferring entries, but if the record is kept prop-

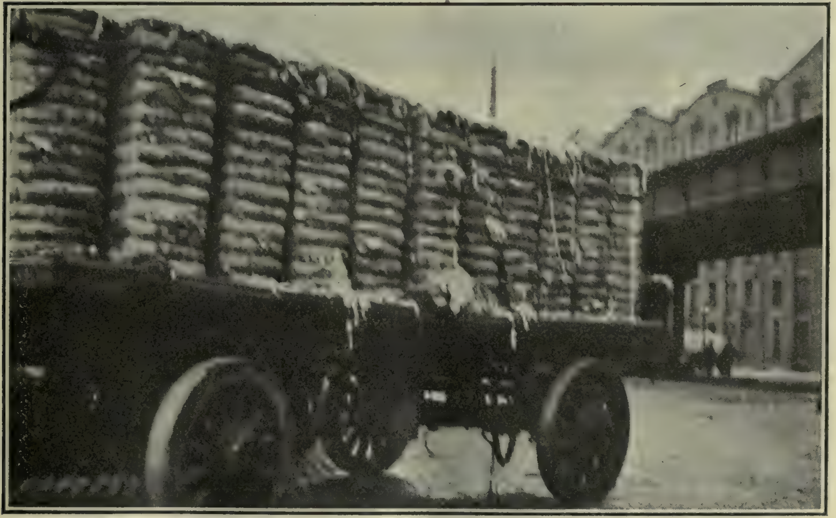


FIG. 24.—Appearance of Indian cotton on arrival at Liverpool, England.

erly it will reduce materially the necessity for added office force at the gin. In the case of a small gin, it will save considerable time and bookkeeping for the manager and enable him to give more attention to other work.

The use of preparatory cleaning processes, cleaner feeders, and huller breasts is a very important factor in the better preparation of cotton for the market, especially in those sections where difficulty is experienced in getting the crop picked clean, or where bad weather prevents the proper maturing of cotton. The gin compress has many advantages, and should be especially profitable to farmers' organizations which bale their cotton for direct marketing.

With 12-inch saws, saw shafts can be operated at considerably slower speeds and still maintain the same capacity as when equipped with 10-inch saws. Such equipment and lowered speed should result in an improvement in the running of the whole plant.

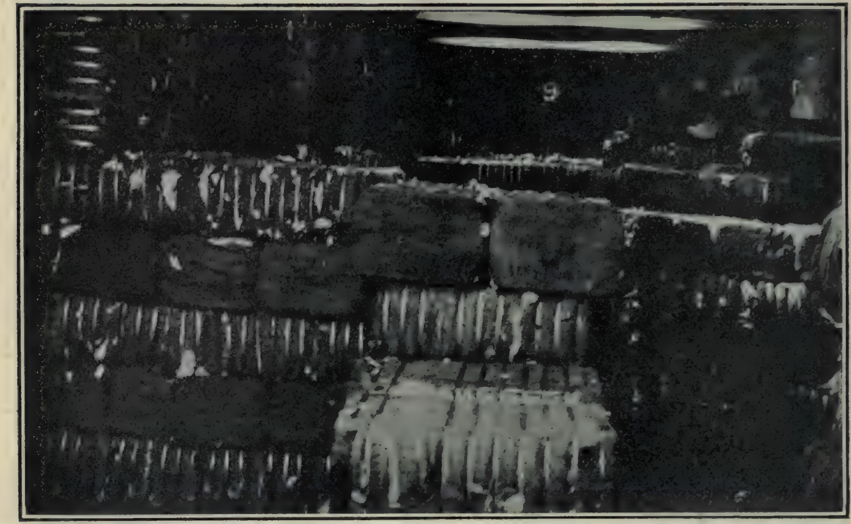


FIG. 25.—Egyptian cotton stored in warehouse at Manchester, England; capacity, 5,300 bales Egyptian cotton, average weight 750 pounds, or a total weight of 3,975,000 pounds. Capacity of these cotton safes, when stored with American cotton, is 3,500 bales, average weight 500 pounds, or a total weight of 1,750,000 pounds. If American cotton were compressed and covered in the same way as Egyptian, many thousands of dollars would be saved to the southern growers each year by reason of lower freight rates, reduced storage charges, and elimination of waste. No photograph of American cotton could be obtained at this place, as American bales are stored only when Egyptian or Indian cotton can not be obtained.

Attention is called to the careless preparation of the American bale of cotton and the seeming indifference to this matter on the part of the farmer, the buyer, and others handling the American bale. It is believed that it is possible to eliminate a part of the loss accruing to the farmer only by bringing to his attention the losses which occur from the time the cotton is ginned until it arrives at the mill, a large proportion of the expense of which is borne indirectly by him.

By concerted action the farmers should be able to secure better methods of ginning, maintain pure planting seed, and secure more uniform and better handling of their cotton, thus enabling them to market their crops to better advantage.

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BREEDS OF SWINE

F. G. ASHBROOK
Animal Husbandry Division

FARMERS' BULLETIN 765
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Animal Industry
A. D. MELVIN, Chief

Washington, D. C. **March, 1917**

THERE are two distinct types of swine, the lard and the bacon types. Swine of the lard type far outnumber those of the bacon type in the United States. The lard type is preferred by the people of this country, consequently the majority of feeders produce the rapid fattening, heavily fleshed lard type.

The bacon type is not raised extensively in the United States. The production of choice bacon is more general in those countries where the feed of the hog is more varied and where corn is not relied upon as the principal grain for hogs.

The principal breeds of the lard type are the Poland-China' Berkshire, Chester White, Duroc-Jersey, and Hampshire.

The principal breeds of the bacon type are the Tamworth and the Large Yorkshire.

There is no best breed of swine. Some breeds are superior to others in certain respects, and one breed may be better adapted than another to certain local conditions. This is a matter which the farmer will have to decide for himself. Information concerning the various breeds of swine, their origin, general appearance, development, and adaptability is given in the following pages.

BREEDS OF SWINE.

CONTENTS.

	Page.
Choosing a breed	3
Classification of swine	3
The lard type of hog	4
The Poland-China	5
The Berkshire	6
The Duroc-Jersey	7
The Chester White	9
The lard type of hog—Continued.	
The Hampshire	10
The bacon type of hog	12
The Tamworth	12
The Large Yorkshire	13
Minor breeds of hogs	14

CHOOSING A BREED.

THE question, "Which is the best breed of swine?" can not be answered by naming any one breed. Some breeds are superior to others in certain respects, and one breed may be better adapted than another to certain local conditions. In general, the "best" hog is the one the farmer likes best, provided it is what his market demands. He will not make a mistake, however, if he makes a selection from the breeds already established in his locality. This is a matter which the farmer will have to decide for himself.

After the farmer has decided upon the breed of hogs which he believes to be the best and most profitable for him to raise, he should stick to that breed and endeavor to develop it to its highest possible standard. It is impossible to get the most out of swine breeding by continually changing from one breed to another. There is adequate room, and market, for the different breeds of hogs, but it would not be profitable for one individual to try to raise several and bring them to perfection.

CLASSIFICATION OF SWINE.

There are two distinct types of swine which have been developed by different methods of breeding and feeding for certain market requirements. They are the lard type and the bacon type. Swine of the lard type far outnumber those of the bacon type in the United States. The former is often called the American type of hog, because in this country it has reached its highest development. The people of the United States generally prefer this type of hog for their purposes; consequently the majority of feeders produce the rapid-fattening, heavily fleshed lard type. Corn, which is largely responsible for this type of hog, is deficient in protein and ash, and has a tendency to produce fat at the expense of lean meat.

The bacon breeds of hogs are not raised in very large numbers in the United States. Where corn is not relied upon as the principal grain for hogs, the production of choice bacon is more general than in the corn belt, even though the so-called lard breeds are used. As the markets become more discriminating, breeders will pay more attention to the production of quality, and with the demand for greater excellence in meat the American or "lard" breeds doubtless will be modified to play a large part in its supply.

THE LARD TYPE OF HOG.

The lard hog is low set and compact, with a very wide and deep body. The shoulders should be full, although not coarse, with full hind quarters and hams carried out straight to the root of the tail and thickly fleshed down to the hock. The flesh should be thick and evenly distributed throughout the body. The size and weight are largely determined by market conditions. Formerly, very heavy hogs were in demand, but at present pigs weighing from 175 to 250 pounds ordinarily command the highest prices. The lard hog does not show the quality and density of bone that prevails in the bacon breeds.

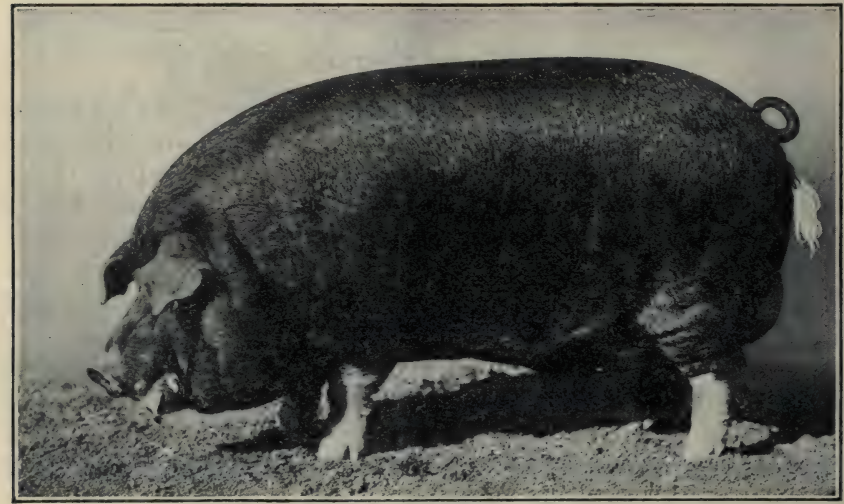

FIG. 1.—Poland-China boar.

The principal breeds of the lard type are the Poland-China, Berkshire, Chester White, Duroc-Jersey, and Hampshire. Ranked according to their numbers and popularity, the breeds of swine most largely raised in North America in the first decade of the twentieth century are the Poland-China, Berkshire, Duroc-Jersey, and Chester White. Of these, the Berkshire is directly of English origin, while the other three may be termed American breeds.

THE POLAND-CHINA.

The Poland-China hog originated in the Miami Valley in Ohio, chiefly in Warren and Butler Counties. At present there are two distinct types in this breed—the large type Poland-China, which is a large, prolific, heavy-boned animal, and the highly refined quality strain or show-ring type. The aim of many breeders for a number of years has been to develop quality, early maturity, and smoothness of form. Some of them, however, have recognized that this type of Poland-China was being produced at the expense of size and fecundity. The Poland-China of early days was a large, rugged, prolific, spotted hog, and, except for the color, breeders of the large type are simply holding to early standards. They have disregarded the fancy type and are breeding hogs which have size and fecundity. The development of more size and bone in the breed is a topic very widely discussed in agricultural papers, and the overrefined type seems to be falling into disfavor with the general farmer.

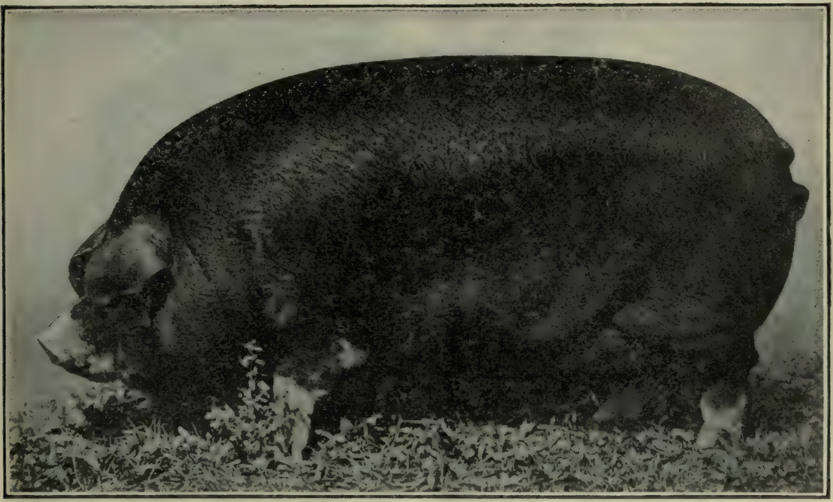

FIG. 2.—Poland-China sow.

In general appearance the Poland-China is compact, symmetrical, full and round, smooth, and inclined to massiveness in build. The color is black with six white markings—the face, feet, and tip of tail. The face is practically straight and the ears droop over about one-fourth to one-third from the tip. The body is smooth throughout, with thick, broad, heavy sides, which are somewhat short but very deep. The hind quarter is thickly fleshed, and the hams are very wide and deep, extending well down on the hocks. The legs are short and the bone fine. Poland-Chinas stand remarkably well on their feet. A broken-down pastern is exceptional in this breed.

The Poland-China is not surpassed by any breed in producing a finished carcass at an early age. The meat of the Poland-China finds ready sale on the market, but it has been criticised for carrying too much fat in proportion to lean.

A very marked criticism of this breed is the lack of fecundity. The large-type strains are less deficient in this respect than the fine-boned strains. The Poland-China is admirably adapted for crossing on common stock for grading purposes, and has been successfully used in different sections of the country for a number of years.

Poland-China pigs fed for market may be made to weigh 200 pounds or over at 6 months. At 1 year old males should weigh about 300 pounds, and sows 250 to 275 pounds. In breeding condition at maturity males should weigh about 500 pounds, and sows 400 pounds.

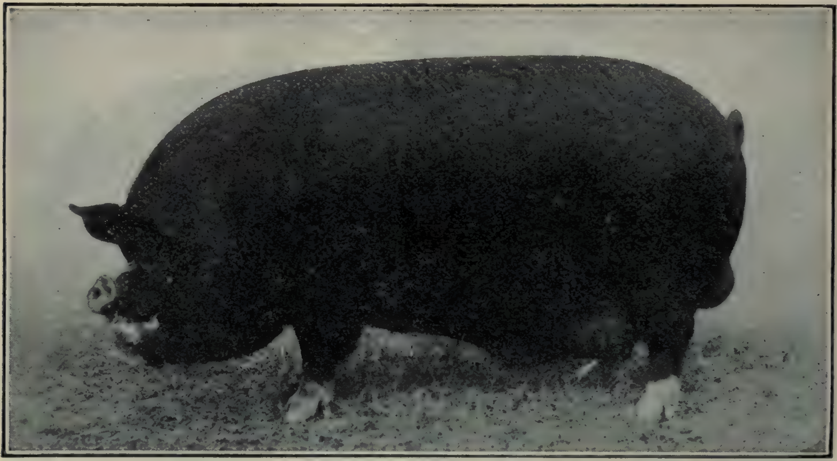

FIG. 3.—Berkshire boar.

There are three associations in the United States that register pure-bred Poland-China hogs: The American Poland-China Record Co., W. M. McFaddan, secretary, Union Stock Yards, Chicago, Ill.; the National Poland-China Record Co., A. M. Brown, secretary, Moorman Block, Winchester, Ind.; the Standard Poland-China Record Association, Ray Davis, secretary, Maryville, Mo.

THE BERKSHIRE.

The Berkshire is one of the oldest of the improved breeds of swine. It was originated and developed in England and was bred there many years before being imported into the United States. The Berkshire is a very attractive animal in appearance and is a little above medium size. The color is similar to the Poland-China, black with white on the feet, face, and tip of tail. An occasional small splash on the foreleg is not regarded as objectionable, although a large white spot on the jowl, shoulder, or other part of the body is regarded by most breeders as objectionable.

The face is medium in length and sharply dished. The ears are erect or slightly inclined forward. The Berkshire has good width and depth of body. The back is broad with good spring of rib and good thickness through the rump and hams. A common fault is that the tail is not set high enough, the rump sloping too rapidly. Representatives of this breed generally stand well on their feet and possess strong, clean bone.

The Berkshire is well adapted for bacon production, although sometimes the shoulder is too heavy and the side lacks the desired length for prime bacon sides. The early-maturing qualities of this breed are good. Generally the sows are more prolific than the Poland-Chinas and somewhat less so than the Duroc-Jerseys and Chester Whites. The Berkshire also ranks high as a grazer. The meat of this breed is of prime quality and the lean and fat are well marbled.

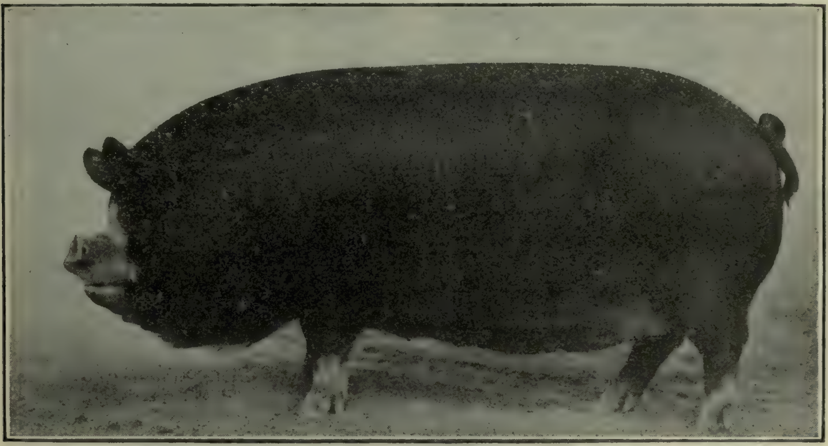

FIG. 4.—Berkshire sow.

The boars are prepotent and impress their characters upon the offspring to a marked degree. Pigs of this breed at 1 year old should readily weigh 300 pounds. In breeding condition mature males should weigh about 500 pounds, and sows 400 pounds.

The secretary of the American Berkshire Association is Frank S. Springer, 510 East Monroe Street, Springfield, Ill.

THE DUROC-JERSEY.

The Duroc-Jersey swine were first bred in New Jersey and other Atlantic States. This breed from its early days has been noted for docility, fecundity, and hardiness. During the last two decades the breed has been improved in quality, ease of feeding, and early maturity, and is now held in about equal favor with the Poland-China in the leading pork-producing areas of the United States. Although the Duroc-Jersey may not produce as high a quality of pork as some other breeds, there is no apparent discrimination against it on the market.

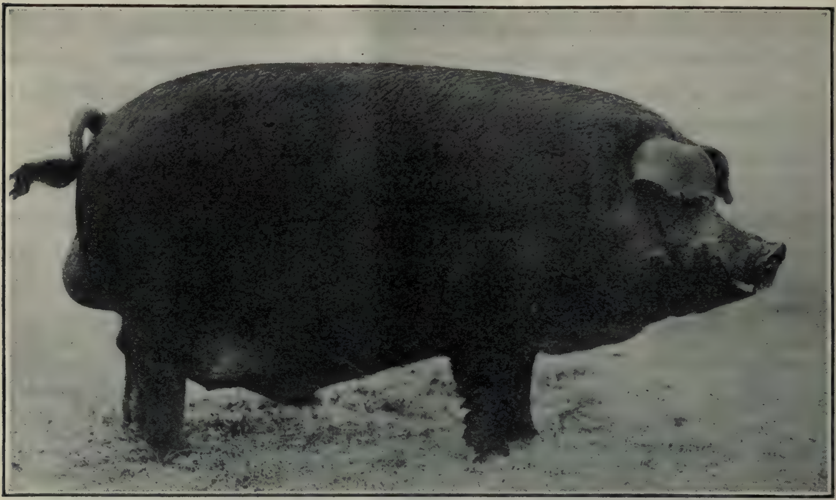

FIG. 5.—Duroc-Jersey boar.

The Duroc-Jersey is similar to the Poland-China in size and conformation; in fact it has often been called facetiously "a red Poland-China." The ears break one-fourth to one-third from the tip, the face is slightly dished, the snout is of medium length, and the shoulders and hams are heavily fleshed. The legs are short and the bone is good. Cherry red is the popular color, but as the hogs grow older the shade becomes darker. Sandy red is objected to by most breeders.

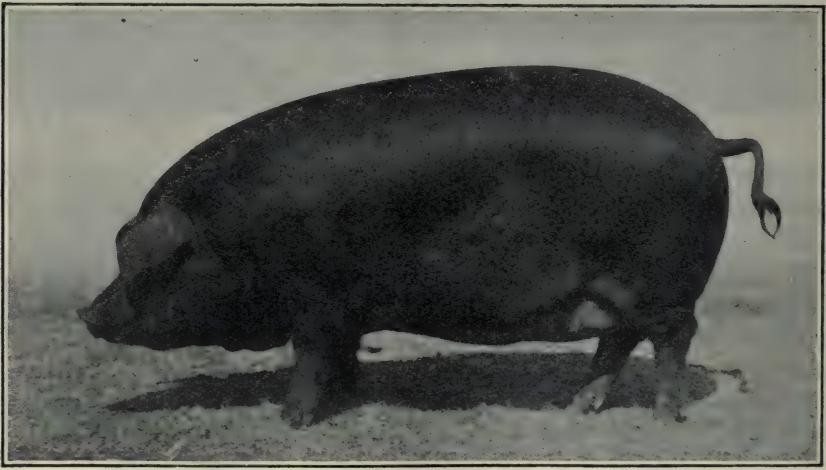

FIG. 6.—Duroc-Jersey sow.

Duroc-Jersey sows are more prolific than Poland-Chinas or Berkshires, and they are also conceded to be better milkers and mothers. The Duroc-Jersey is also one of the best grazers and is especially adapted to following cattle in the feed lot. As an early maturing hog it ranks high, and crosses well with other breeds, but the Berkshire and Poland-China crosses seem to be the most popular. At maturity a boar should weigh about 600 pounds, a sow 500 pounds.

The secretary of the American Duroc-Jersey Breeders' Association is Robert J. Evans, Union Stock Yards, Chicago, Ill.; the secretary of the National Duroc-Jersey Record Association is J. R. Pfander, Peoria, Ill.

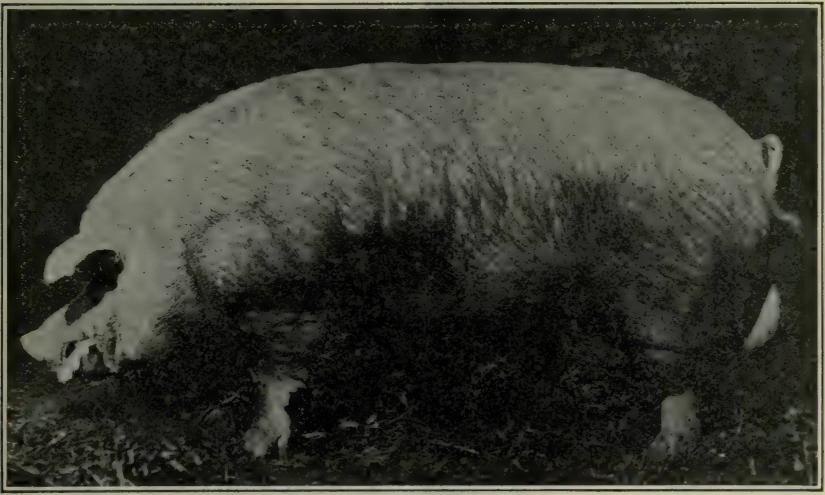

FIG. 7.—Chester White boar.

THE CHESTER WHITE.

The Chester White hog originated early in the nineteenth century in Chester County, Pa. The breed is now widely distributed in the United States. It is popular in the East, and is strongly represented in Ohio, Illinois, Indiana, Iowa, Michigan, and Pennsylvania.

The Chester White is moderately long, thick, and deep, possessing strong bone, but somewhat loosely coupled. The original Chester Whites were dished slightly in the face, but the dish has disappeared and the present-day animals possess straight faces with rather long snouts. The ears droop about one-third the distance from the base.

In conformation the Chester White is long but not so deep in body as the Poland-China. The legs are short but some individuals may lack strength in the pasterns. The color is white and the hair has a tendency to be wavy. Black and bluish spots on the skin are not uncommon, but breeders aim to prevent them as much as possible.

The sows rank high in point of fecundity, and are exceptionally good mothers and milkers. The Chester White crosses well with almost any breed, but to obtain the best results they should be crossed on pigs possessing superior bone and feet. As a feeder the Chester White ranks high and the quality of its flesh is good. Mature males in fair flesh weigh 600 pounds, and sows about 450 pounds.

There were at least eight associations for recording Chester Whites a few years ago, but they are now reduced to two, namely: The Chester White Swine Record Association, secretary, F. F. Moore, Rochester, Ind.; and the O. I. C. [Ohio Improved Chester] Swine Breeders' Association, secretary, O. C. Vernon, Goshen, Ind.

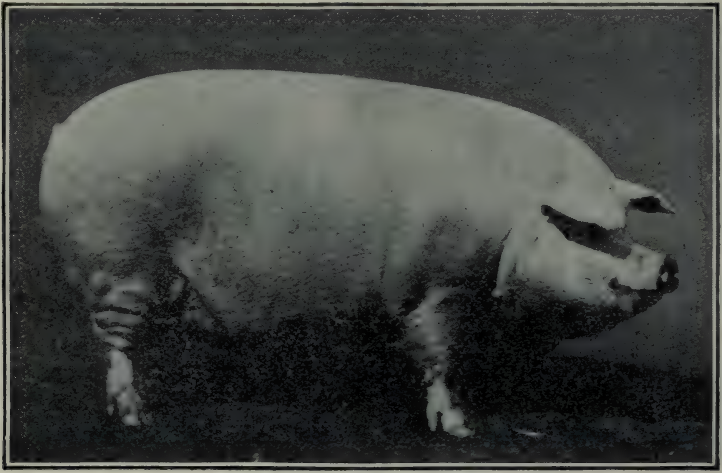

FIG. 8.—Chester White sow.

THE HAMPSHIRE.

The Hampshire originated in the English county of the same name, and was introduced into the United States during the first half of the last century. This breed is sometimes classed between the fat or lard hog and the bacon type, but most breeders consider it as belonging in the former class. The Hampshire has made rapid progress of late years, but in comparison with the older-established breeds the number in any one State is not large, owing to the fact that the breed has only recently come into prominence.

The most characteristic feature of the Hampshire is the white belt around its body, including the shoulder and front legs, while the rest of the body is black, some individuals being entirely black. The most popular color, however, consists of black with a white belt from 4 to 12 inches wide encircling the body and including the forelegs.

The Hampshire in general appearance is rather upstanding on legs that are fine-boned but of good quality and strong, with strong and upright pasterns. The body is not very broad, but deep; the jowls are light, the head small, the snout rather straight and medium in length. The head is narrow, the ears set close and extending forward, but not breaking. The shoulders are smooth and well set, the back is strong and arched, the hams are deep and broad, but not very thick. In quality the flesh of the Hampshire has a very high reputation. It has made a good record in the dressed-carcass competition at the International Live Stock Exposition at Chicago. The flesh is of good grain with a desirable percentage of lean to fat.

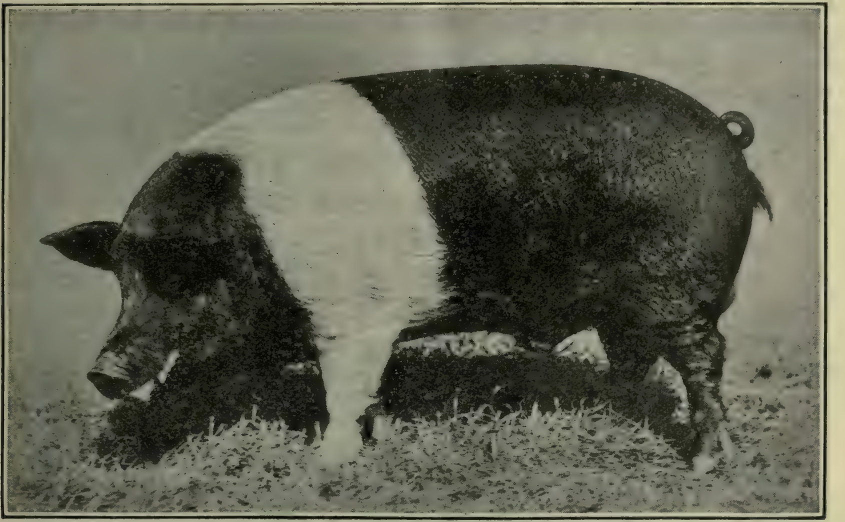

FIG. 9.—Hampshire boar.

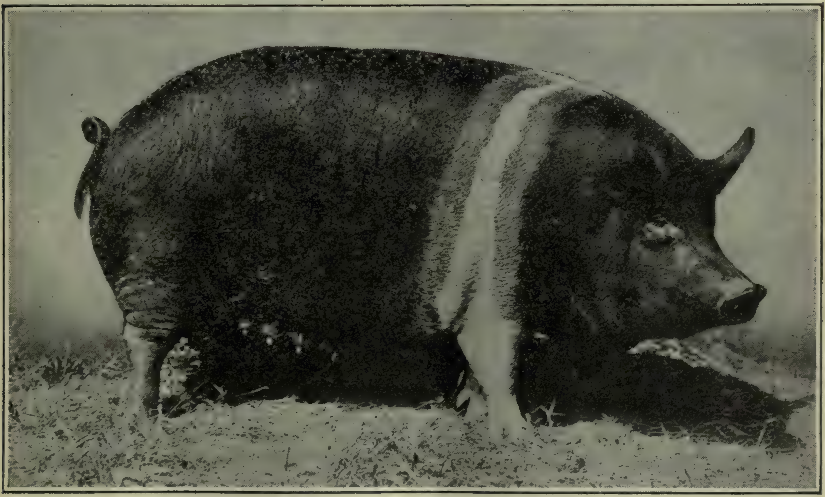

FIG. 10.—Hampshire sow.

The Hampshire possesses good early maturing and feeding qualities, and the sows are prolific; the breed is also a good grazer. Owing to the fact that the Hampshire has only recently come into prominence, its value for crossbreeding is not well known, but it seems reasonable to suppose that it should cross well with fat types of hogs. In breeding condition mature males should weigh 500 pounds, mature sows about 400 pounds.

The secretary of the American Hampshire Record Association is E. C. Stone, 703 East Nebraska Avenue, Peoria, Ill.

THE BACON TYPE OF HOG.

In conformation the bacon type of hog is very different from the lard type, being longer in leg and body, with less width of back, and lighter in the shoulders and neck. On first sight this type is lean and lanky in appearance. The spring of rib in a bacon hog is very characteristic. The side of the hog is used for the production of bacon; hence much emphasis is laid on the development of the side. The bacon hog possesses great length and depth of body and is very smooth throughout. Large, heavy hams are not desirable on the bacon hog; the hams should be smooth and taper toward the hock.

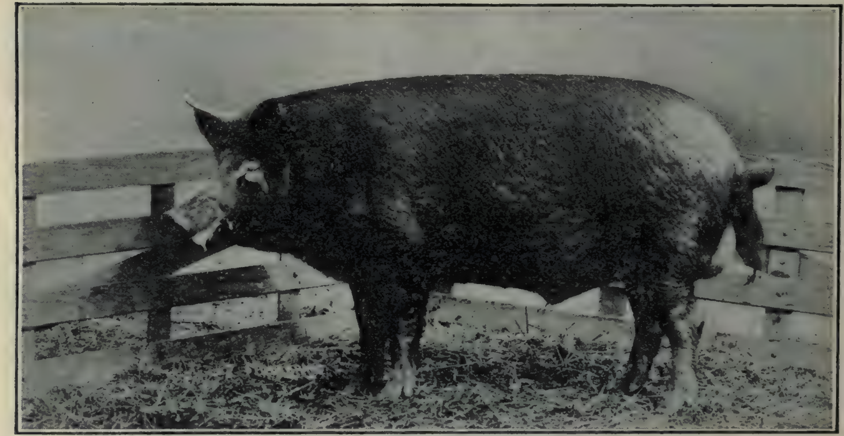

FIG. 11.—Tamworth boar.

The Tamworth and the Yorkshire breeds are both of British origin and are recognized as being especially suitable for bacon production.

THE TAMWORTH.

Of all breeds the Tamworth is probably the purest. There is no evidence of its having been crossed with any other breed. In general outline the Tamworth is long, smooth, and fairly deep, having a moderately light fore end and deep ham. The snout is rather long and pointed, the neck is light and muscular, the jowls are light, the ears are large and usually upright, but often inclined forward. Although the legs of the Tamworth are long, they are strong and the pasterns erect.

The color is red, varying from light to dark. A "golden-red hair on a flesh-colored skin, free from black," is preferred. Tamworth pigs do not mature early. The bacon is of exceptionally fine quality, well mixed with lean, and fine grained. The Tamworths are good rustlers. The sows are more prolific than those of the lard breeds, and the boars are very prepotent. A mature boar in good condition should weigh about 650 pounds and a sow 600 pounds. Many individuals weigh more.

The secretary of the American Tamworth Swine Record Association is E. N. Ball, Hamburg, Mich.

THE LARGE YORKSHIRE.

The Yorkshire is a white breed of English origin. Black spots on the skin do not disqualify, but the aim of the breeder should be to reduce them to a minimum. The presence of black hairs is regarded by authorities as sufficient to justify disqualification.

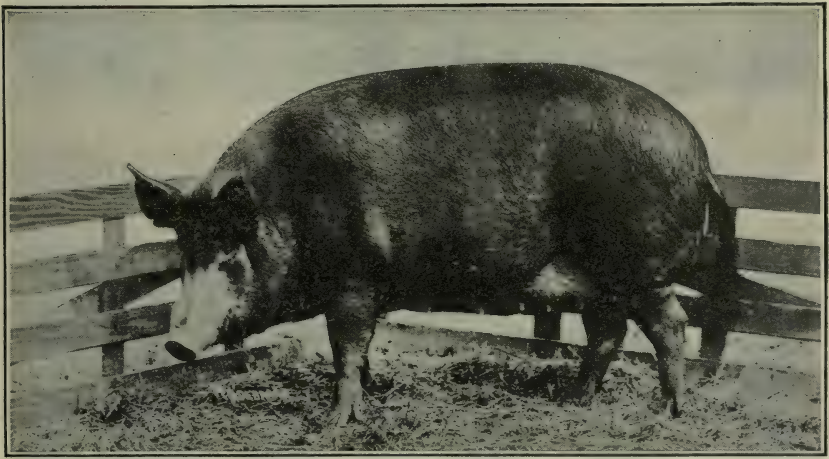

FIG. 12.—Tamworth sow.

The conformation is typical of the bacon hog in general; that is, upstanding, comparatively narrow, deep, and long, with light shoulders and hams. The back is slightly arched and the ribs well sprung. The underline and sides are trim, straight, and level. The body is supported by well-placed legs of medium length. In Denmark, England, Ireland, and Canada, where the raising of pigs for bacon is an important industry, the Large Yorkshire with its crosses is the most common breed used.

The Large Yorkshire boar is very valuable for crossing upon breeds which are fine in bone and lacking in size and fecundity.

Large Yorkshire sows make good mothers, and the boars are exceptionally prepotent. A mature boar in good condition should weigh not less than 700 pounds and a mature sow 600 pounds.

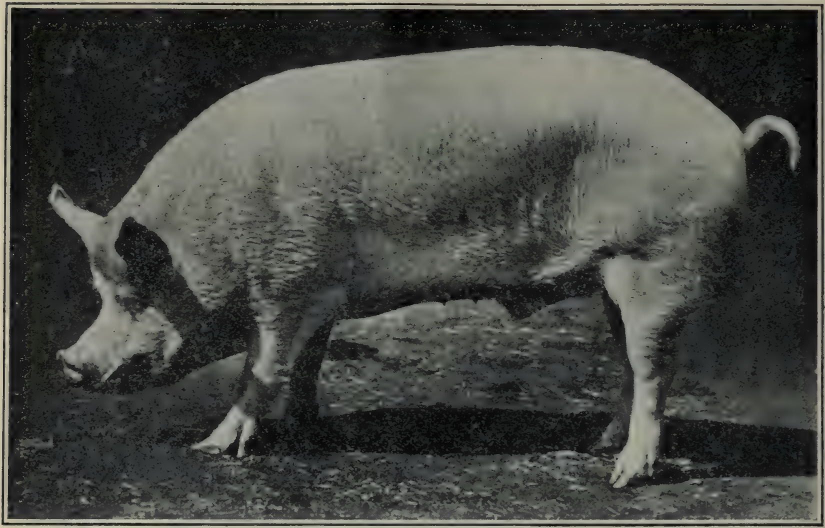

FIG. 13.—Yorkshire boar.

The secretary of the American Yorkshire Club is Harry G. Krum, White Bear Lake, Minn.

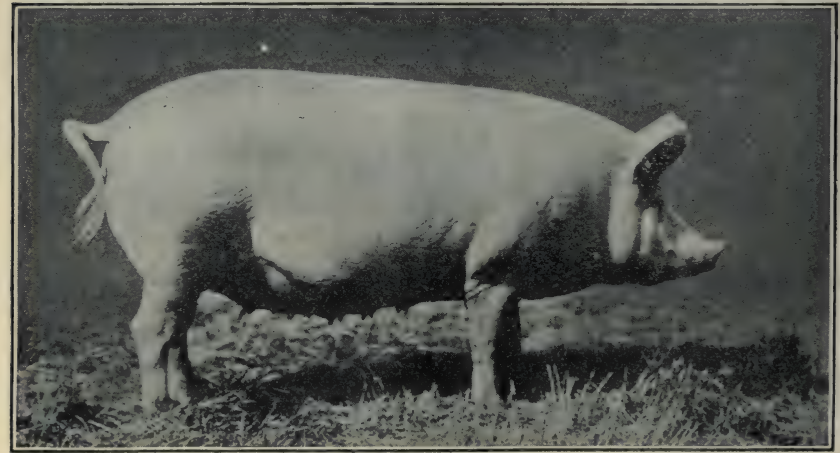

FIG. 14.—Yorkshire sow.

MINOR BREEDS OF HOGS.

Besides the breeds that have been discussed there are others, such as the Mule-foot, Cheshire, Essex, Small Yorkshire, Victoria, and Large Black, which have not been bred to any great extent in the United States and are not numerous.

THE MULE-FOOT HOG.

The Mule-foot, or solid-hoofed, hog is not numerous nor widely distributed in the United States. Its characteristic peculiarity is the solid hoof. The breed, however, is growing in favor in some sections. The claim made that Mule-foot pigs are immune to hog cholera is not justified by experience.

There are three associations which have been organized to handle the registration and pedigrees of the Mule-foot hog: The National Mule-foot Hog Association, G. C. Kreglow, secretary, Degraff, Ohio; the Mule-foot Hog Breeders' Association, D. D. Gilson, president, Mammoth Springs, Ark.; the American Mule-foot Hog Record Co., R. E. Pfeiffer, secretary, 507 Chamber of Commerce, Columbus, Ohio.

THE CHESHIRE.

The native home of this breed is Jefferson County, N. Y., on the eastern shore of Lake Ontario. In general conformation this breed ranks intermediate between the lard type and the bacon type. The color is white, the head of medium length, the face slightly dished; the ears are small, fine, and stand erect. The body is of medium width, depth, and length.

The general quality of the meat is unexcelled. The lean and fat are well mixed and the meat well marbled. The sows are fairly prolific and the boars prepotent.

The secretary of the Cheshire Swine Breeders' Association is E. S. Hill, Freeville, N. Y.

THE ESSEX.

This breed was developed in Essex County, England, where there formerly existed a rather small, flat-ribbed, slow-maturing hog of a nervous disposition. In England the Essex is often spoken of as the small Black or Black Suffolk. The Essex belongs to the small breeds, being smaller than the Berkshire or the Poland-China. The color is entirely black, no white being admissible. The head is short, the face slightly dished, while the ears are small, fine, and carried erect. The Essex is a short, thick, deep, chunky type of pig, with short, fine-boned legs. The meat is fine and of good flavor, but possesses a tendency to excessive fatness. The lack of size prevents this breed from becoming popular with the average farmer.

The secretary of the American Essex Swine Association is F. M. Srout, Box 141, Annawan, Ill.

THE SMALL YORKSHIRE.

The Small Yorkshire comes from England, where it is known as the Small White, the name Small Yorkshire being of American origin. This is the smallest breed in the United States.

The head is remarkable. The snout is very short and turned-up, the face is wide and small, the ears erect, the jowl heavy, and the neck very short. The body is short, thick, and deep, and the bone is very fine in quality. The color is white, and the hair abundant and fine.

The Small Yorkshire is but slightly bred to-day, either in England or America. There are some small herds in the eastern United States, in New York, Massachusetts, and Pennsylvania.

The American Yorkshire Club registers both Large and Small Yorkshires in the United States. The secretary is H. G. Krum, White Bear Lake, Minn.

THE VICTORIA.

The breed which is known today as the Victoria was originated by George F. Davis, of Indiana, and Col. F. D. Curtis, of New York. The Victoria is a white hog of medium size. It has a rather short head and a medium-dished face, ears small and carried erect, shoulders and hams thick and full, with good length and depth of side. The quality of the meat ranks high; the breeding qualities are also good. The breed is not growing in public favor.

THE LARGE BLACK.

The origin of this breed of swine is not well known, but it has been bred for a great many years in England. It is not common in the United States. The breed is large, coarse, and all black in color, with very large, drooping ears. In general conformation it approaches the bacon type of hog. In England the main claims made for the Large Black are its bacon qualities. However, at the Ottawa agricultural experimental station in Canada it was found that the bacon of this breed was not equal to that of the Large Yorkshire or of the Tamworth.

The Large Black is considered a first-class breed for farmers in England. The sows are prolific and excellent mothers.

The secretary-treasurer of the American Large Black Pig Society is J. F. Cook, Lexington, Ky.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1917

UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 766 NOVEMBER 20, 1916

Contribution from the Bureau of Entomology, L. O. Howard, Chief.

THE COMMON CABBAGE WORM.[1]

By F. H. CHITTENDEN, *Entomologist in Charge of Truck-Crop and Stored-Product Insect Investigations.*

INTRODUCTORY.

The most destructive of the many insect and other enemies of cabbage and related crops over the United States generally is the larva or caterpillar of the imported cabbage butterfly (figs. 1, 2), sometimes called the white butterfly or rape butterfly, a familiar object to nearly everyone. This caterpillar, the imported cabbage worm, is well known to farmers throughout this country and in the Old World as well, and the butterfly is generally recognized by the farmer as the parent of the "worms."

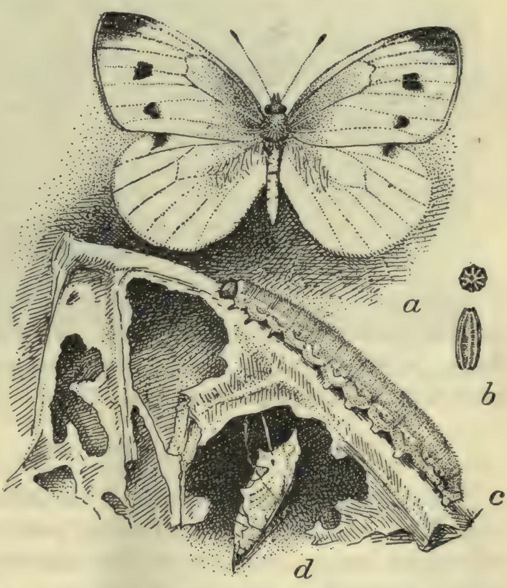

FIG. 1.—The common cabbage worm (*Pontia rapae*): *a*, Female butterfly; *b*, above, egg as seen from above; below, egg as seen from side; *c*, larva, or "worm," in natural position on cabbage leaf; *d*, suspended chrysalis. *a*, *c*, *d*, slightly enlarged; *b*, *more enlarged.* (Author's illustration.)

DESCRIPTIVE.

THE CATERPILLAR.

This cabbage worm is velvety green, about the same color as the cabbage on which it feeds. There is a faint yellow stripe down the middle of the back and a row of yellow spots along each side in line with the spiracles or breathing

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[1] *Pontia rapae* L.; order Lepidoptera, family Pieridae.

NOTE.—This bulletin is intended to assist cabbage growers to control one of their most troublesome pests.

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pores. The surface of the body, if viewed through an ordinary hand lens, is seen to be somewhat rough and finely dotted with small black spots. It measures, when full grown, about an inch and a fourth in length, presenting the appearance shown in figure 1, *c*. It differs from the cabbage looper,[1] another caterpillar found on such crops, in having five pairs of prolegs (unjointed hind legs) instead of four.

THE BUTTERFLY.

The butterfly (fig. 2) has a wing expanse of nearly 2 inches. It is white, marked with black near the tips of the forewings, as shown in figure 1, *a*, which represents the female. In the female there are two conspicuous black spots on each forewing, whereas the male (fig. 2) has only one. Each sex has a corresponding smaller black spot at the front edge of the hind wing. The body of the female is whitish, but that of the male is usually darker above. The male is generally the smaller. The underside of the hind wing is a uniform straw yellow of satiny aspect, and there are generally two black spots showing through in both sexes.

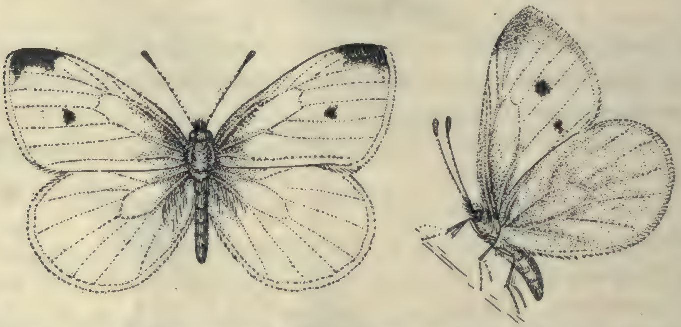

FIG. 2.—The common cabbage butterfly: Male, wings spread at left, wings folded at right. Somewhat enlarged. (Author's illustration.)

THE EGG.

The eggs are turnip-shaped, pale yellowish, and strongly ribbed (fig. 1, *b*), and may be seen readily with the unaided eye. They are deposited singly, usually on the underside of the outer leaves of cabbage and their other food plants.

THE CHRYSALIS.

When the caterpillar or "worm" becomes full-grown it attaches itself to a cabbage leaf or other near-by object by means of a thread-like girdle of silk, and often within the same day transforms to the chrysalis (fig. 1, *d*). The chrysalis is of variable color, being influenced in this respect by the object upon which it is fastened. The color thus varies through dirty gray to yellow, green, and dark gray. The length of the chrysalis is a little less than three-fourths of an inch.

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[1] *Autographa brassicae* Riley.

NATURE OF INJURY.

This cabbage worm has been rightly termed the bane of the cabbage grower and the dread of every careful cook and housewife. It begins work early in the season; the principal damage is therefore to young plants (fig. 3), and accrues through the necessity of replanting, with attendant increase in cost of production, due to additional labor, cost of stock, and delay in getting the early or better prices in the market. After riddling the outer leaves, which remain afterwards attached to the stalk, the caterpillar attacks the tender inner leaves as they form, frequently secreting itself in the immature heads, where it is difficult to reach it with insecticides, and rendering the cabbage unfit for food because of the abundant dark green excrement which it deposits. As a result, cabbages before being sent to market must be examined carefully and the damaged leaves removed. Before cooking it is frequently necessary to tear the heads apart to insure that no disgusting worms are concealed within, and even after the vegetable is prepared for the table there is danger of an admixture of animal matter with the vegetable food. In cool weather the caterpillar often feeds freely exposed on the surface of the leaves in the sunshine.

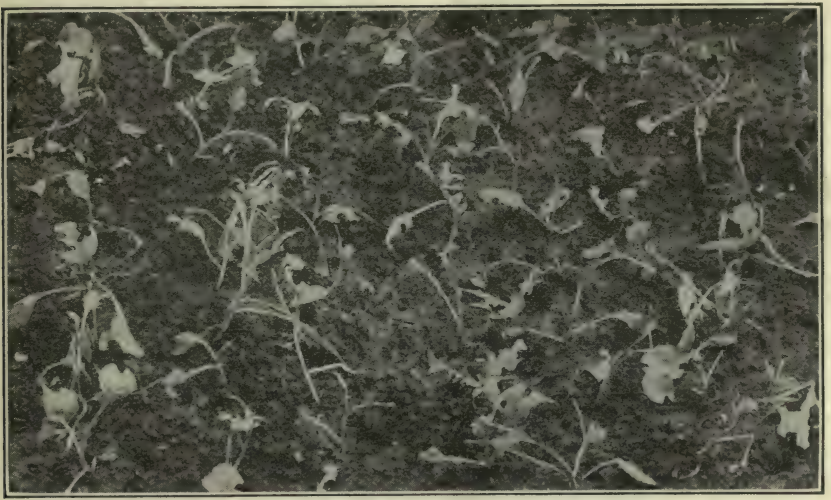

FIG. 3.—Cabbage seedlings grown in cold frames, showing injury by common cabbage worm. This necessitates replanting and additional labor, and causes delay in getting cabbage on the early market. (Original.)

Frequently the caterpillar bores into the center of the cabbage, attacking what is commonly known as the "heart," and then the entire head is worthless for market. Figure 4 illustrates this form of injury. Seedling cabbage grown in cold frames is also often damaged. Injury of this nature may be very serious, many of the plants being a complete loss, while the remainder make poor growth. Figure 5 illustrates an unusual form of damage in which the insects occur in such numbers as to congregate on a single leaf and ruin it in a very short time. This illustrates complete defoliation, and also is an indication of the sluggish habits of the larvæ during resting periods.

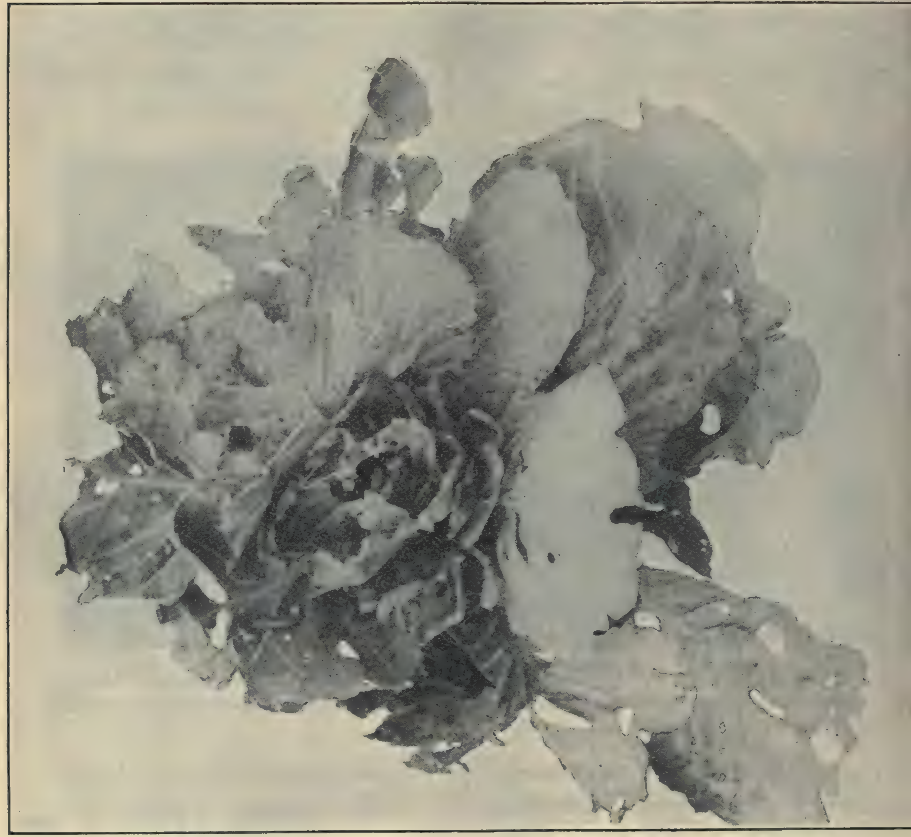

FIG. 4.—Cabbage showing severe injury by the common cabbage worm. This cabbage plant w never make a marketable head. (Original.)

As early as 1869, when this cabbage worm was confined to limited areas in Canada, New England, and New York, it did great damage. At St. Albans Bay, Vt., in that year it caused the total destruction of a crop of 3,000 cabbage plants. The worms made their appearance about the 1st of September, and there were from 10 to 50 on a head. The Abbé Provancher estimated the same year a loss of $240,000 in the vicinity of Quebec alone. One farmer near Montreal lost in a single season over 12,000 heads of cabbage. The following year in some places about New York City, where the insect had appeared only the year before, the entire crop of cabbage and cauliflower was destroyed. The loss in this case was estimated at half a million dollars.

Owing to the fact that during recent years arsenicals have been very generally used to control the cabbage worm, there are now few instances in any part of this country of the total destruction of crops of cabbages as was formerly often the case. Nevertheless a conservative estimate would place the present annual loss from this pest to cabbages alone (not including cauliflower and other related crops) at $1,300,000, or one-tenth of the entire crop.

ORIGIN, SPREAD, AND PRESENT DISTRIBUTION.

The imported cabbage butterfly was introduced from Europe, and was first recognized from a capture at Quebec, Canada, in 1860. It was not seen again until two years later, in the same locality. After a lapse of several years it was reported at intervals from other portions of Canada. In 1865 its first appearance in the United States was noted in Maine; the following

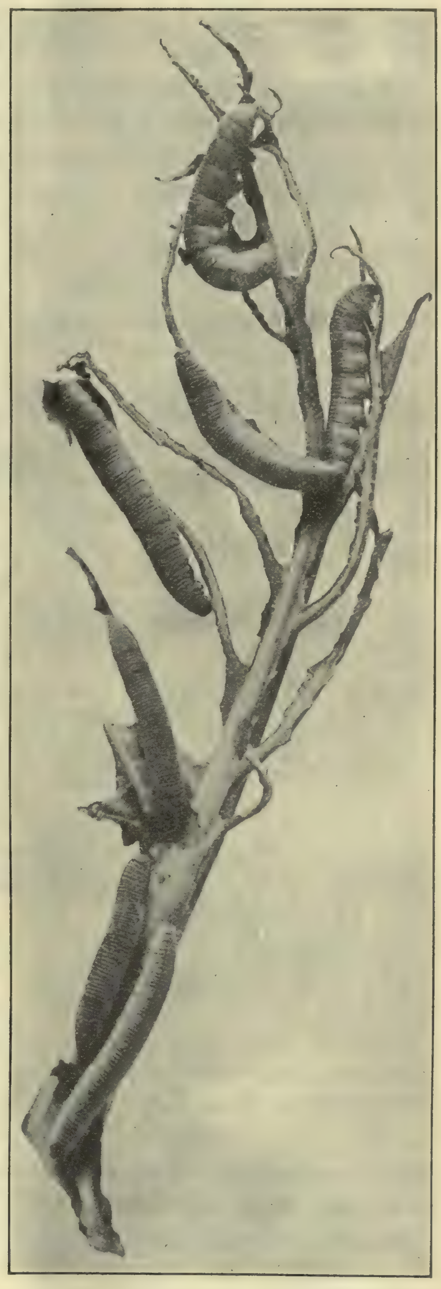

FIG. 5.—Cabbage leaf completely defoliated by seven common cabbage worms. Slightly enlarged. (Original.)

year, in northern New Hampshire and Vermont. In 1868 it had reached New York, and soon thereafter began to attract attention in new localities. In 1875 it appeared in Cleveland, Ohio, and two years later in Illinois. In 1880 it had penetrated southward to the Gulf States. This distribution has continued until now the species is known in practically every State in the Union. It appears to favor no particular part of the country, being as destructive in the Gulf region as in Canada and New England. In the Western Hemisphere this butterfly ranges from the Atlantic to the Pacific, in most localities between the thirtieth and sixtieth degrees of latitude.

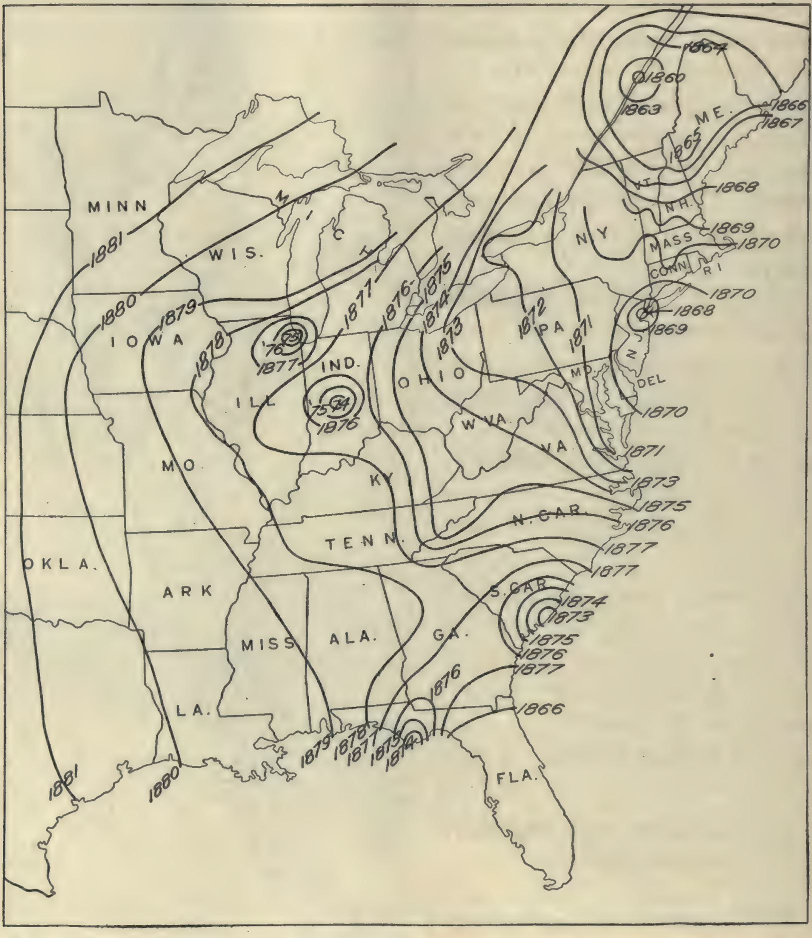

FIG. 6.—Map showing spread of common cabbage butterfly from 1860 to 1881. (Adapted from Scudder.)

The accompanying map (fig. 6) shows approximately how this species has spread, chiefly by flight, according to the opinion of the late Dr. S. H. Scudder, who was the highest authority on American butterflies. The westward spread has not been followed carefully.

FOOD HABITS.

The imported cabbage worm feeds on all forms of cruciferous plants, is particularly fond of cabbage and cauliflower, and is somewhat less destructive to turnip, kale, collards, radish, mustard, and horseradish. It also does considerable damage to ornamental plants, such as nasturtium, mignonette, sweet alyssum, the spider plant (Cleome), and exceptionally to lettuce.

The butterflies sip the nectar of flowers of various kinds and may be seen at any time hovering over them. They are especially fond of the white blossoms of crucifers, and of the flowers of white aster, lavender, purple heliotrope, and thistle. Like other butterflies, this species is active by day, and is on the wing from early morning until near dusk. It is a comparatively slow, tireless flyer, being capable of extended flight for long distances. The butterflies sometimes congregate in immense swarms, as has occurred frequently when they have emigrated from the continent of Europe to England, and their occurrence in midocean has been recorded.

LIFE HISTORY.

The butterflies appear on warm sunny days as early as March, even in the Northern States, and thereafter may be seen flying until after several severe frosts in October. In the Gulf region they occur throughout the season.

Pairing and egg laying begin within a day or two after the adult issues from the chrysalis. The duration of the different stages naturally varies with temperature conditions, that of the egg period being from 4 to 8 days.

The caterpillar eats voraciously and grows rapidly, attaining maturity in from 10 to 14 days after hatching. It molts four times; hence there are five distinct instars or substages, the first molt taking place, in the warmest weather, in about 2 days from the time of hatching, the second stage lasting from 2 to 3 days, the third and fourth from 1 to 2 days each, and the fifth from 4 to 5 days. The duration of the chrysalis stage is from 7 to 12 days during the summer time, but the last chrysalides formed in the more northern States remain in suspense during the winter and develop the following spring.

The life cycle occupies periods varying between 22 days and 5 to 6 weeks. Even in New England this species is credited with being triple brooded, but in the District of Columbia and vicinity there must be one or more additional generations, with a possibility of at least six in the extreme South. The first generation develops on wild plants.

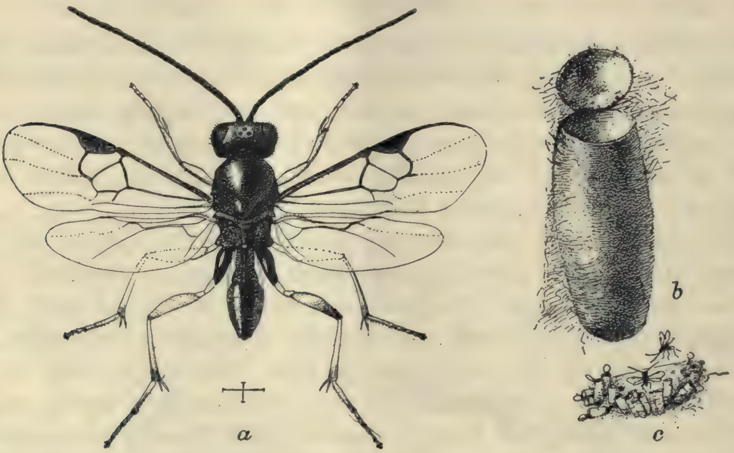

FIG. 7.—An ichneumon fly, *Apanteles glomeratus*, a valuable parasite of the common cabbage worm: *a*, Adult fly; *b*, cocoon; *c*, flies escaping from cocoons. *a*, *b*, Highly magnified; *c*, natural size. (Author's illustration.)

NATURAL ENEMIES.

Were it not for certain effective checks this species would be a still greater pest. The most important of its insect enemies are small parasites, all introductions from Europe. One of them, an ichneumon fly[1] (figs. 7, 8), was purposely imported in 1883 from England. During the autumn of 1904 this species held its host under complete control at Washington, D. C., killing every "worm" which came under the writer's observation. A larva which has been destroyed by this parasite is shown in figure 7, *b*, together with the parasite's cocoon. A minute chalcis fly[2] was present as a parasite of the beneficial ichneumon fly, but apparently did not destroy the effectiveness of the latter. Another chalcis fly[3] (fig. 9) which bears the same

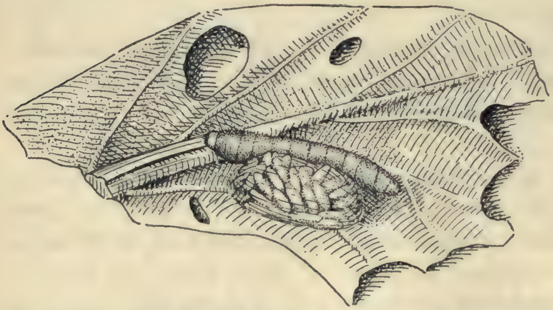

FIG. 8.—Parasitized cabbage worm, showing cocoon mass of ichneumon fly, *Apanteles glomeratus*, below. (Author's illustration.)

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[1] *Apanteles glomeratus* L.; order Hymenoptera, family Braconidae.

[2] *Tetrastichus microgastri* Bouché.

[3] *Pteromalus puparum* L.

relation to the cabbage worm as does the ichneumon fly, and is therefore beneficial, was first noticed in this country in 1869, evidently having been imported with the host. The eggs of this species are deposited in the cabbage worm, which, while completing its transformation to pupa, dies, and the parasites issue from the latter.

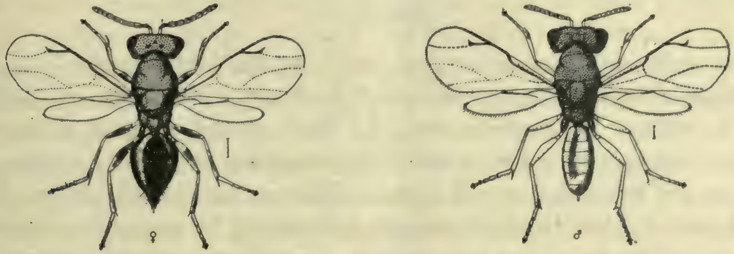

FIG. 9.—A chalcis fly, *Pteromalus puparum,* a parasite of the common cabbage worm: Female at left, male at right. Greatly enlarged. (Author's illustration.)

Wasps, particularly certain paper wasps[1] and related forms, are also of great service in reducing the numbers of this and other cabbage worms, appearing to prefer them to other prey.

The small, evil-smelling ambush-bug[2] (fig. 10) secretes itself in flowers, such as the thistle and goldenrod, and destroys numbers of butterflies, capturing them and sucking out their body fluids.

Numerous other enemies[3] attack this cabbage worm, and it is sometimes subject to a contagious bacterial disease[4] similar to that of the cabbage looper. It is, however, less susceptible to this malady, although in some seasons, for example, in 1916 in southern California, great numbers are destroyed by it.

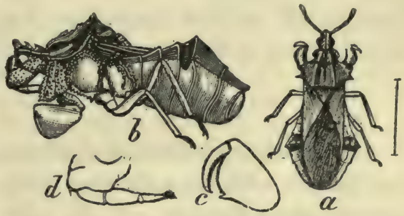

FIG. 10.—An ambush-bug, *Phymata wolffii,* which preys on butterflies of the common cabbage worm: *a,* View from above; *b,* view from side; *c,* front leg; *d,* beak. *a, b,* Enlarged; *c, d,* more enlarged. (Riley.)

Birds which are known to feed upon cabbage worms are the chipping sparrow, English sparrow, and house wren. It is certain, however, that other species eat them, and in one case it was found that during the winter the number of pupæ of the cabbage butterflies was reduced more than 90 per cent by birds feeding upon them.

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[1] *Polistes metricus* Say, *pallipes* Lepel., *et al.*

[2] *Phymata wolffii* Stal.

[3] Among other predacious enemies observed in this country are the wheel bug (*Arilus cristatus* L.) and the armed soldier-bug (*Podisus maculiventris* Say). The cabbage worm is also parasitized by the tachina flies *Exorista vulgaris* Fall and *Frontina archippivora* Will., as well as by *Sarcophaga* (*Boettcheria*) *latisterna* Parker. About 10 additional European parasites are listed.

[4] *Micrococcus pieridis* Burrill.

METHODS OF CONTROL.

The imported cabbage worm is not difficult to control, and it should be borne in mind that most other "worms" will be controlled by the same methods, and that other cabbage pests are more often present than not.

ARSENICALS.

Repeated experiments have shown that the best remedy is one of the arsenicals; and that arsenate of lead and Paris green are preferable to others in common use. If Paris green is used it may be applied either wet or dry, preferably, however, as a spray, at the rate of 1 pound to 50 gallons of water. The plants should be free from insect attack when they are set out, and should be sprayed a few days later to make sure that the poison reaches the young caterpillars before they have burrowed far into the heads. Other applications should follow as inspection of plants shows that they are necessary. These applications of arsenicals can be made with absolute safety until the heads are nearly formed, and, for that matter, even later, as the poison disappears from plants almost completely within two to three weeks after application, and even earlier in event of repeated or heavy rainfall. After the removal of the outer leaves, in preparation of the cabbages for market, and after other leaves have been picked off, as is done before the cabbages are cooked or cut up for salad, there is usually very little, if any, of the arsenic left.

HARMLESSNESS OF ARSENICALS WHEN PROPERLY APPLIED.

Chemical analysis has shown that cabbage which has been sprayed or dusted with an arsenical as prescribed, and prepared for cooking in the usual manner a week later, has not even a trace of the arsenic remaining. The use of arsenicals against cabbage worms is almost universal in the United States, although growers are sometimes loath to acknowledge the fact for fear of the loss of customers who are not fully acquainted with the harmlessness of the remedy. There are no authentic recorded instances known to the writer of poisoning from the consumption of cabbage treated with an arsenical. It has been proved that 28 cabbage heads, dusted in the ordinary way with Paris green, would have to be eaten by an adult human at one meal before poisonous effects could be produced. The experience of a Virginia market gardener who dusted his cabbage with Paris green and flour, omitting to inform his family of the fact, should be cited. A day or two later he ate heartily of this cabbage, as did others, and afterwards was questioned by his wife as to the peculiar powdery substance on the heads. Although poisoning was anticipated, no ill results followed.

ARSENATE OF LEAD.

As a result of the abnormal conditions incident to the European war, there is a scarcity of Paris green, which has naturally increased the cost. Arsenate of lead, however, which has been rapidly superseding Paris green and other arsenicals as an insecticide, has not increased proportionately in price, and for many reasons is preferable.

It has the advantage of being less harmful to growing plants and adheres better to the foliage, is less apt to burn the leaves of delicate plants, and is less troublesome to prepare. It serves the same purpose as Paris green and is applied in the same manner. It is sold both in paste and in dry powder form. Two pounds of dry lead arsenate to 50 gallons of water or Bordeaux mixture will make a solution of sufficient strength to destroy cabbage worms and similar insects. It may, indeed, be used as strong as 1 pound to 10 gallons of water on hardy plants without injury, but this is inadvisable because of the increased cost, the danger of scorching young plants, and the fact that, thus used, it is no more effective than the prescribed dose. The paste form must be used at double strength, or 4 pounds to 50 gallons of water. The number of sprayings to be applied depends on local and seasonal conditions. Sometimes a single spraying at the proper time will suffice, but usually two or three applications are necessary for cabbage worms which have more than one generation. The adhesiveness of the spray material is promoted by the addition of about the same amount by weight of resin-fishoil soap as of the arsenical used.

Arsenate of lead as a spray is valuable in that it leaves, on drying, a white coating on the plants, so that after spraying it can be determined readily which plants have been treated and which have not been reached.

Extensive experiments have proved that, for economy and efficiency, the best form of spraying machinery should be used. In regard to nozzles the "Vermorel," "cyclone," and "mistry" types are most effective as well as the most economical. When the arsenical is forced through a nozzle of this type the spray is mist-like in appearance and adheres to the foliage instead of forming small drops which quickly roll off the smooth leaves of cabbage plants. The best sprayer is the compressed-air type, constructed for use both by hand and by machinery, the latter to be driven by horsepower.

POISONED-BRAN MASH.

A mixture of bran with Paris green, the standard remedy for cutworms and grasshoppers, is, according to the testimony of some who have used it, successful against "cabbage worms," and should be tested against the imported cabbage worm. Any arsenical can be employed in the preparation of this mixture. It is best to mix the bran with the poison and sugar before adding the water. The proportions are 2 or 3 ounces of sugar or other sweetening, a teaspoonful of Paris green, and about 1 pound of bran, to a gallon of water; so as to make, when stirred, a mixture that will easily run through the fingers. In its application it is merely sprinkled, either wet or dry, over the affected plants.

THE HOT-WATER REMEDY.

As long ago as 1883, water at a temperature of about 130° F. was advised as a remedy for this cabbage "worm." It does practically no harm to the plants and kills all insects with which it comes in contact. It is scarcely applicable to large fields, however, on account of the difficulty of maintaining the proper temperature.

CONTACT POISONS.

Kerosene emulsion is not as effective as the arsenicals, because in its application it is necessary for the spray to come into direct contact with the larvæ or "worms" in order to kill them.

When strong soap solutions are used on ornamental plants infested by aphides or plant-lice and this species is also at work, such insects as are actually touched will be killed. Where the plants affected are attacked by thrips and other minute insects, and such contact poisons as nicotine sulphate are employed, these will also kill cabbage worms, but none of the poisons of this nature are standards for the chewing insects like the cabbage worms, and are not recommended except in the case of the occurrence of sucking insects on the same plants. A combination spray of an arsenical mixed with nicotine sulphate, kerosene emulsion, or soap is sometimes used with good effect to kill both aphides, or thrips, and cabbage worms.

PYRETHRUM.

Pyrethrum insect powder is not so useful as an arsenical. Of its effectiveness, Dr. James Fletcher, late entomologist of the Dominion of Canada, wrote that "diluted with four times its weight of common flour and then kept tightly closed for 24 hours (before use), it leaves nothing to be desired, and thousands of dollars are saved yearly to small growers, who most need assistance." Pyrethrum is rather costly, varies as to purity, and is said to discolor the leaves, but it has the advantage of being nonpoisonous to human beings and domestic animals. If used too sparingly a portion of the caterpillars are merely numbed and eventually recover. Younger caterpillars are more susceptible. It can not be recommended for use on large areas.

HAND METHODS.

For the kitchen garden, hand picking is sometimes practiced, especially when plants are first set out. It is laborious, although effective if the work is carefully conducted.

CLEAN FARMING AND TRAP CROPS.

If cooperation in clean methods of farming and in the use of arsenicals could be secured by any possibility, much of the loss due to the ravages of this pest might be averted. The practice of leaving cabbage stalks in the field after the main crop has been harvested is reprehensible. All remnants should be gathered and destroyed, with the exception of a few left at regular intervals through a field as lures to induce the female butterflies to deposit their eggs upon them. Such stalks, being useless, should, where feasible, be poisoned freely with arsenicals so that the last generation will have no place to develop in the fields.

UTILIZATION OF NATURAL ENEMIES.

It is matter of common observation, frequently recorded, that two parasitic enemies of this species do excellent service in reducing the numbers of their host, viz, the cabbage-worm chalcis fly[1] and an ichneumon fly.[2] (See pp. 8–9.) The former issues from the chrysalides through minute holes in the dry outer skins. The latter issues from the caterpillars and forms masses of yellow cocoons. As soon as these cocoons are seen, all caterpillars that can be collected should be gathered carefully with portions of the leaves to which they are attached and transferred to barrels or large boxes, which should be covered with wire netting of a mesh which will permit the parasites to emerge but will prevent the butterflies from escaping. An ordinary screen mesh of 12 to the inch or coarse mosquito netting will answer this purpose. In addition, a few holes should be bored into the bottom of the barrel or box used for this purpose, small enough to prevent the caterpillars from escaping. This will permit rain water to drain off which might otherwise drown the insects.

SUMMARY.

The imported cabbage worm is a velvety green caterpillar measuring about an inch and a fourth when full grown. It is the larva or young of a white butterfly. It begins work soon after young plants are set out, and in the case of cabbage riddles the outer leaves and bores into the heads. As a result entire crops are often lost.

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[1] *Pteromalus puparum.*

[2] *Apanteles glomeratus.*

It was introduced from Europe and has been known in the United States since 1865. It has become a most serious drawback to the cultivation of cabbage, cauliflower, turnip, and related crops in this country.

The first generation is produced on wild cruciferous plants, and the second attacks crop plants. It is capable in the warmest weather of developing from egg to adult or butterfly in 22 days. Even in its northernmost range it is triple-brooded, and southward there may be as many as six distinct generations.

Two natural enemies contribute considerably to the decrease of this species, otherwise it would be a pest of still greater severity.

The best remedies are the arsenicals, of which arsenate of lead and Paris green are the most efficient; the former, being cheaper at the present time, is recommended at the rate of 2 pounds in powder form or 4 pounds in paste form to 50 gallons of water. Adhesiveness is enhanced by the addition of about the same amount by weight of crude resin soap or resin-fishoil soap.

The best form of spraying machinery should be used, with special attention to nozzles in order to secure a mist-like spray.

The arsenicals are harmless when properly applied as directed.

In addition to the persistent use of arsenicals, clean farming should be pursued in cooperation with neighboring cabbage growers to obtain the best results.

It is advisable to encourage the parasites above-mentioned according to the directions given.

Finally, cooperation in the use of arsenate of lead as a spray and in maintaining clean farming and other methods is highly desirable in all communities. If this could be practiced on an experimental scale under proper supervision the results would soon be apparent. It must be kept up year after year, however, owing to the constant migration and invasion of this cabbage worm from other sources.

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GOOSE RAISING

HARRY M. LAMON and ALFRED R. LEE
Of the Animal Husbandry Division

FARMERS' BULLETIN 767

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from Bureau of Animal Industry
A. D. MELVIN, Chief

Washington, D. C. February, 1917

THE Toulouse and the Embden are the most popular breeds of geese in this country. The Toulouse is the largest breed, the adult gander weighing 25 pounds and the goose 20 pounds.

Geese can be raised in small numbers successfully and at a profit on many farms where there is low, rough pasture land containing a natural supply of water.

They need a house only during cold or stormy weather, when an open shed should be provided.

Large boxes, barrels, or shelters are provided as nests for geese, or they are allowed to make nests on the floor of the house.

Adult geese should be fed for eggs about February 1, or so that the goslings will be hatched by the time there is good grass pasture. Feed a mash in the morning of equal parts by weight of corn meal, bran, and middlings, or low-grade flour, with 10 per cent of beef scrap, and give whole or cracked corn at night.

Goslings should be fed a mash of 2 parts shorts and 1 part corn meal by weight, changing at the end of three weeks to equal parts shorts and corn meal, with 5 per cent each of beef scrap and grit.

A fattening ration may be made of a mash of 1 part shorts and 2 parts corn meal by weight, with 5 per cent of beef scrap, which is fed in the morning, while corn is fed at night.

The period of incubation of goose eggs varies from 28 to 30 days. The first eggs usually are set under hens, while the last eggs which the goose lays may be hatched either under hens or under the goose if she becomes broody.

Further information with regard to the setting of eggs, as well as other details of the management of geese, are given in this bulletin.

GOOSE RAISING.

CONTENTS.

	Page.		Page.
Goose production	3	Feeding geese and goslings	12
Breeds	3	Preparing for market	13
Goose breeding	7	Reports from breeders	14

GOOSE PRODUCTION.

GEESE are raised successfully in all parts of the United States, but are most abundant in the South and the Middle West. According to the census of 1910, Kentucky, with 400,000, contained the greatest number of geese, but this number was nearly equaled in each of the States of Tennessee, Missouri, and Arkansas. The total number of geese declined about 22 per cent from 1900 to 1910, due largely to the lack of cheap pasture land for grazing and perhaps partly to the limited demand for goose feathers and goose flesh. The last factor may be partly owing to the size of a goose, which is too large for the average family, and partly to the prevailing opinion that goose flesh is very greasy; this condition, however, is largely caused by improper cooking, by the failure to remove the sulplus fat of the abdominal cavity, and by not skimming off the grease while cooking.

BREEDS.

Six breeds of geese have been admitted to the American Standard of Perfection, namely, Toulouse, Embden, Chinese, African, Wild or Canada, and Egyptian. In addition to the standard breeds there is the so-called Mongrel goose, which is a hybrid made by crossing one of these varieties, or the common goose, with wild geese. Crosses of the varieties of geese, especially of the Toulouse and Embden, are occasionally made, but without any apparent gain. The common goose found on many farms contains more or less blood of some of the standard breeds and of the Wild goose, and is usually considerably smaller than the Toulouse or the Embden. It may be improved by crossing with a pure-bred gander. The Toulouse, Embden, Chinese, and African are easily the most popular breeds of geese in this country, the first two greatly leading the other breeds. All economic breeds of geese are kept primarily for the production of flesh and feathers, although their eggs are occasionally used for culinary purposes.

THE TOULOUSE GOOSE.

The Toulouse goose (see illustration of gander on title-page and of goose as fig. 1) derives its name from the city of Toulouse, in southern France, in a territory noted for its geese. The Toulouse is the largest of the standard breeds of geese; the adult gander weighs 26 pounds, the adult goose and the young gander 20 pounds, and the young goose 16 pounds. The color of the plumage is dark gray on the back, gradually shading to light gray edged with white on the breast, and to white on the abdomen. The eye should be dark brown or hazel; the bill pale orange, and the shanks and toes a deep reddish orange. The body is massive, of medium length, broad and very deep, almost touching the ground. The female resembles the male, but is smaller. The Toulouse is a good layer, producing from 20 to 35 eggs a year; is docile, grows rapidly, and makes a good market bird. However, its dark pinfeathers make it a slightly less attractive market goose than the Embden.

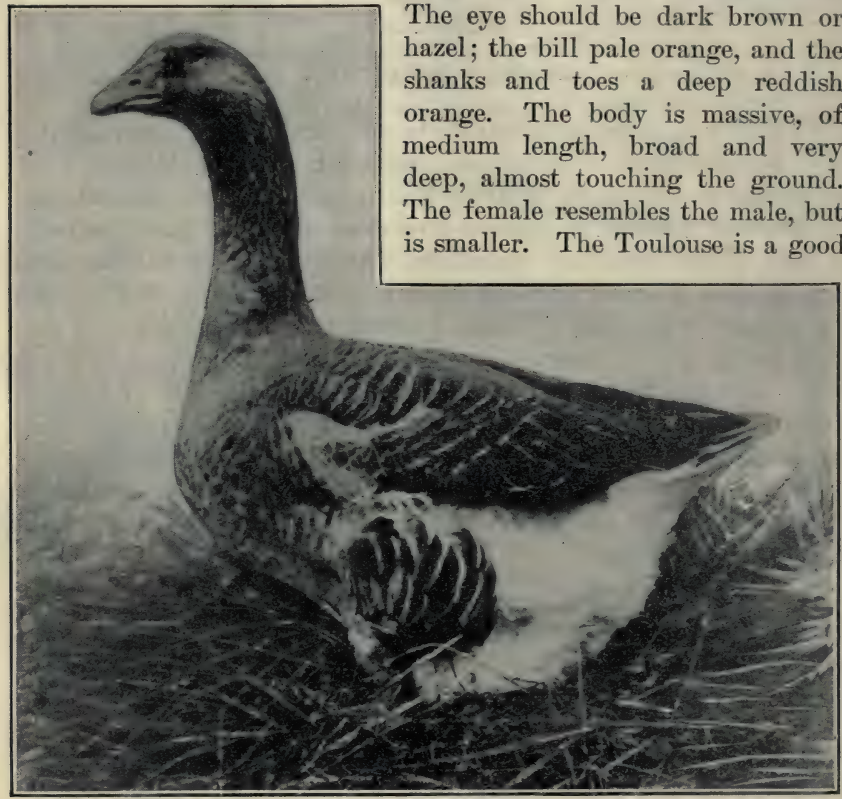

FIG. 1.—Toulouse goose.

THE EMBDEN GOOSE.

The Embden (fig. 2) was one of the first breeds of geese imported into the United States, where they were known as Bremen, from the city whence they came. It is a large white goose, slightly smaller and with somewhat longer legs than the Toulouse. The standard weights are, for adult gander and goose, 20 and 18 pounds; young gander and goose, 18 and 16 pounds, respectively. The plumage is pure white. The Embden is only a fair layer, usually less prolific than the Toulouse, although the egg yield varies greatly among individuals in all the breeds. This breed makes a very good market bird, as it has white pinfeathers, is a rapid grower, and matures early.

THE AFRICAN GOOSE.

The African (fig. 3) is a gray goose with a distinct brown shade, about the size of the Embden; it has, however, a distinctive knob or protuberance on its head, and its carriage is more erect and the body more oblong than the Toulouse. The standard weights are the same as for the Embden, except that those of the young gander and goose are 16 and 14 pounds, respectively. The head, knob, and bill are black, the eyes are dark brown, the plumage dark gray on the wings and back and gray or light gray on the neck, breast, and underside of the body. The African is a good layer and makes a good market goose, although it has the objectionable dark pinfeathers. It is a rapid grower and matures early.

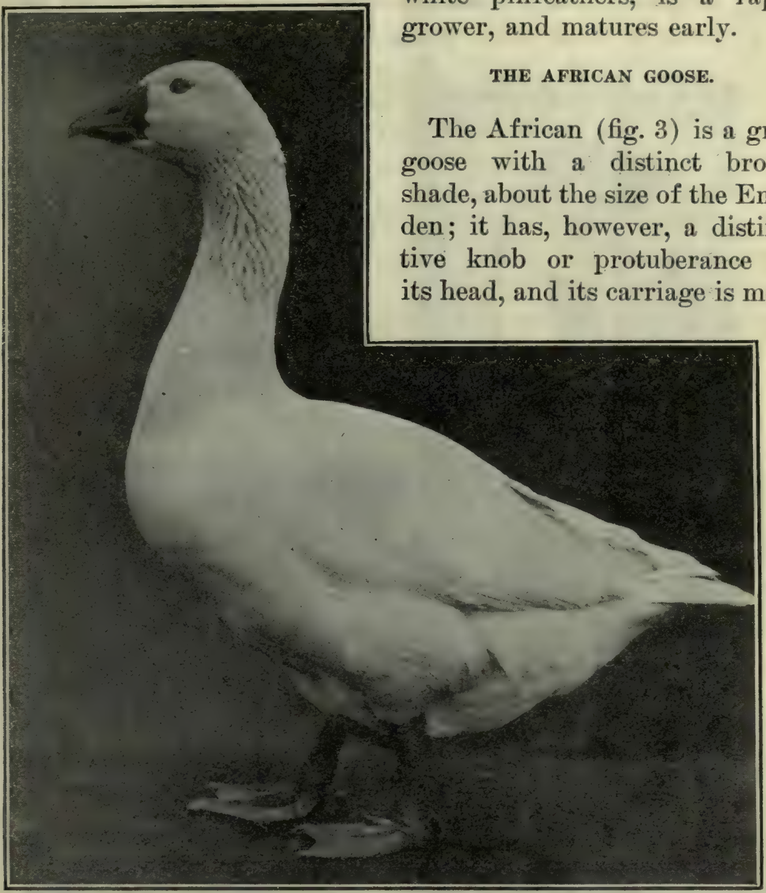

FIG. 2.—Embden gander.

THE CHINESE GOOSE.

There are two standard varieties of Chinese geese, the Brown and the White (figs. 4 and 5). The standard weights are, adult gander and goose, 12 and 10 pounds; young gander and goose, 10 and 8 pounds, respectively. The Brown goose has a grayish-brown color which is lighter on the underside of the body, with a brown head, a dark-brown or black knob, and a black bill. The White goose has a pure white plumage with an orange-colored bill and knob. Both varieties mature early and are said to be prolific layers and rapid growers, but shy and rather difficult to handle.

THE WILD OR CANADA GOOSE.

The Wild goose (fig. 6) is bred to some extent in captivity, and the young are sold to hunters to use as decoys. The Wild gander is used to cross with either the common or the pure-bred goose, producing the so-called Mongrel goose. This Mongrel goose is highly prized as a market goose, but is usually sterile and will not breed. The standard weights of the Wild goose are the same as those of the Chinese goose. The body should be gray or dark gray in color, the breast light gray, and the lower part of the body white from the legs to the tail. The bill, eyes, head, neck, and tail are black. This goose

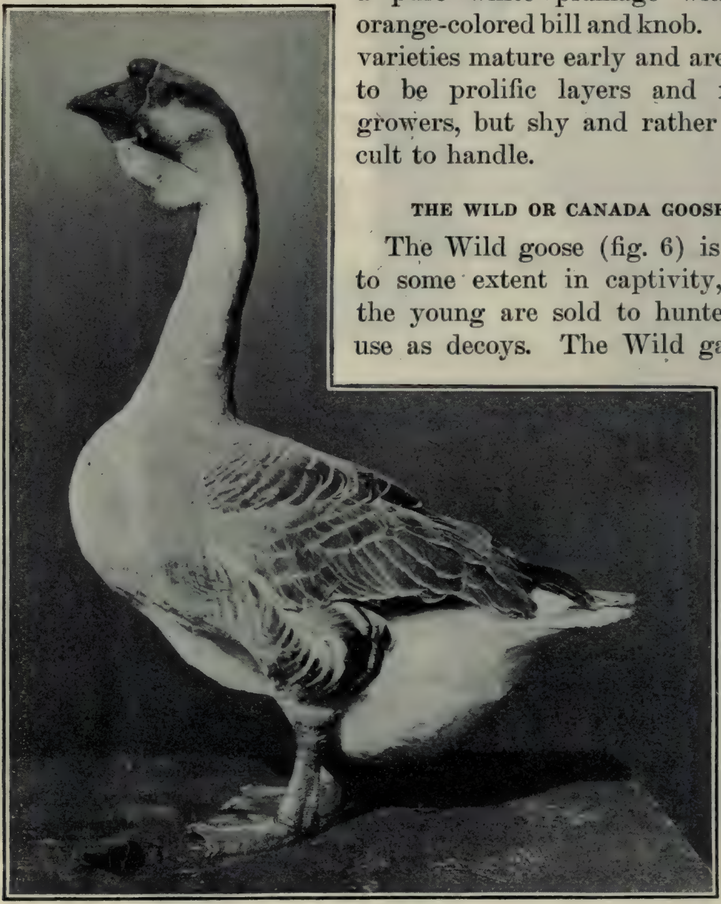

FIG. 3.—African gander.

is said to be a rather poor layer and is sometimes difficult to breed successfully in captivity.

THE EGYPTIAN GOOSE.

This is a small brightly colored goose kept for ornamental purposes and rarely seen in this country. It resembles the Wild goose in shape and weighs 2 pounds less in each class. The bill is purple or bluish red, and the legs and toes are reddish yellow. The color of the plumage of the back and body is gray and black, with the lower part of the body pale buff or yellow, penciled with black. The breast is chestnut and gray, and the tail is black. The wings are a glossy black with white shoulders.

GOOSE BREEDING.

Practically all the geese in the country are raised in small flocks on general farms (see figs. 7 and 8), and few if any farms are devoted entirely to raising geese. The fattening of geese, however, is conducted as a special business in the producing sections, in which case the geese are collected from general farms, usually over a large area,

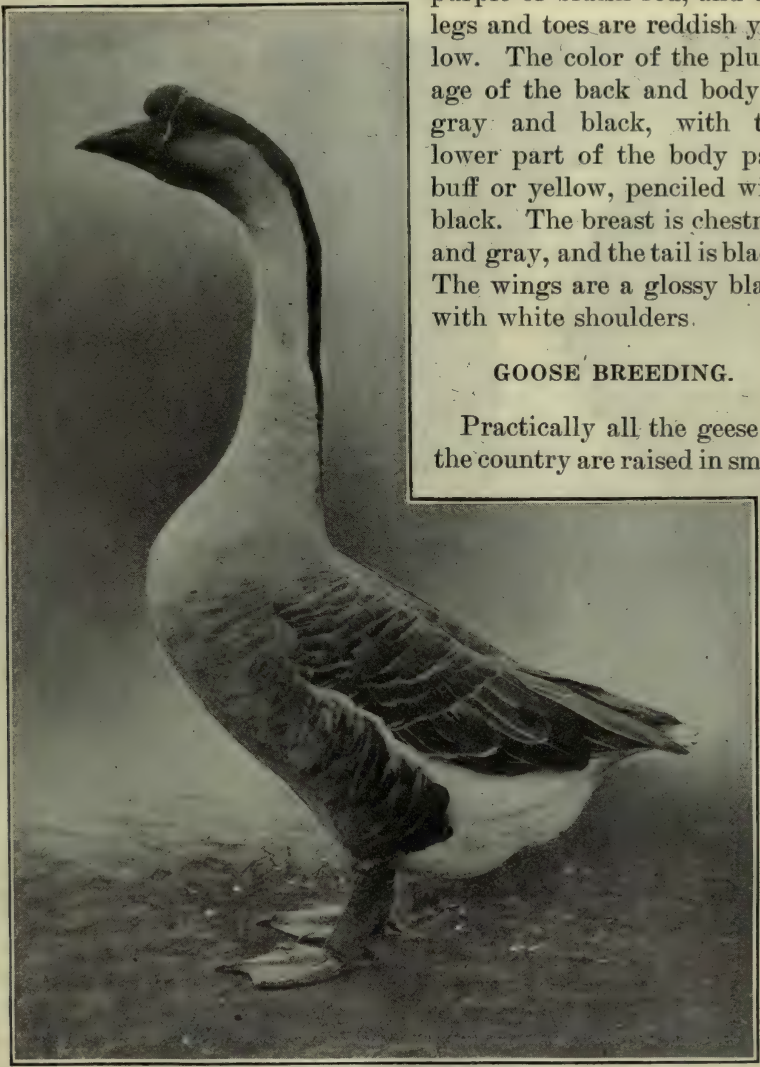

FIG. 4.—Brown Chinese gander.

and fattened for a few weeks before they are killed. Geese can be raised in small numbers successfully and at a profit on farms where there is low rough pasture land with a natural supply of water. Geese are generally quite free from disease and all insect pests, but occasionally are affected by the diseases common to poultry. Grass makes up the bulk of the feed for geese, and it is doubtful whether it pays to raise them unless good grass range is available. A body of water where they can swim is considered essential during the breeding season and is a good feature during the rest of the year. The market for geese is not so general as for chickens; this should be considered in undertaking the raising of geese. The demand and the price paid for geese are usually good in sections where goose fattening is conducted on a large scale. Many geese are kept in the South for the production of feathers rather than for their flesh, but the demand for their feathers is not so good as it has been, making the business less profitable.

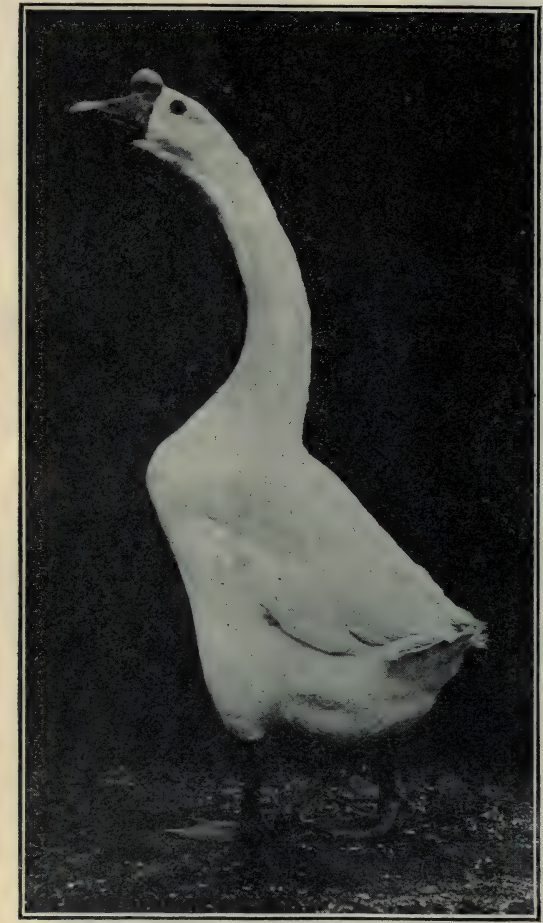

FIG. 5.—White Chinese gander.

HOUSES.

Except in winter or during stormy weather, when some protection should be provided, mature geese do not usually need a house. Some kind of shelter, such as a shed open on the south side, a poultry house, or a barn is usually provided by breeders in the North and is used by many in the South. Coops, barrels, or some other dry shelter should be provided for young goslings. The goose houses should be kept clean and plenty of clean straw provided for the floor.

SELECTING AND MATING.

Geese, like other kinds of poultry, should be selected for size, prolificacy, and vitality. They should be mated several months prior to the breeding season to obtain the best results; therefore breeding stock should be bought in the fall. Goose matings are not changed from year to year unless the results are unsatisfactory. Sex is difficult to distinguish in geese, especially when they are young. The gander is usually somewhat larger and coarser than the goose and has a shrill cry, while the female has a coarse cry. The male has a heavier, longer neck, and a larger head. The sex may be determined by inspecting the sexual organs or by the actions of the geese at mating time. The sphincter muscle which closes the anus of the female is folded and winding or sinuous if stretched, while a light pressure on the corresponding section in the male will make the sexual organ protrude. This test is more easily made on a mature male and in warm weather. In common geese the male is lighter colored than the female.

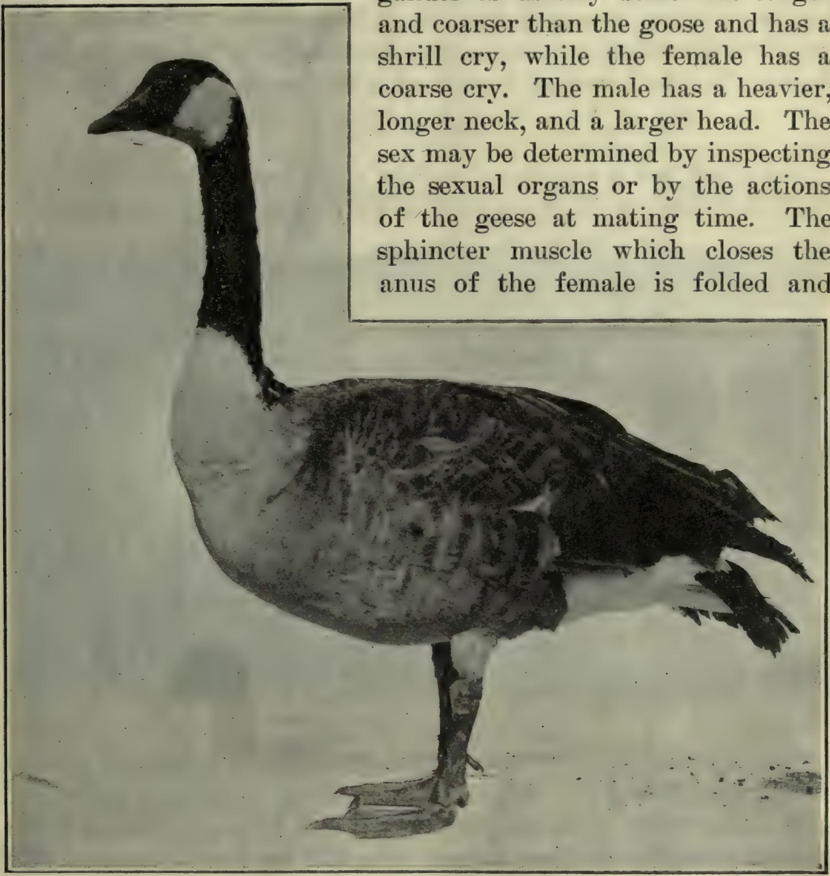

FIG. 6.—Wild or Canada gander.

A gander may be mated with from one to four geese, but pair or trio matings usually give the best results. The Wild gander usually mates with only one goose.

When mated, geese are allowed to run in flocks. (Figs. 7 and 8.) From 4 to 25 geese may be kept on an acre of land, and under most conditions 10 is a fair average. Wherever possible the geese should have free range. Many people in the South keep them to kill the weeds in the cotton fields.

Toulouse and Embden geese will breed when about 2 years old, but do not mature for another year. The females are usually kept until they are 12 to 14 years old, or as long as they lay well, but ganders are not generally kept after they are 8 to 9 years old; Wild ganders, however, are kept as long as they will breed. Geese are usually best for breeding when from 3 to 5 years old.

INCUBATION.

Geese are fed a ration to produce eggs during the latter part of the winter (about February 1) or so that the goslings will be hatched by the time there is good grass pasture. They are allowed to make nests on the floor of the house, or large boxes, barrels, or shelters are provided for that purpose. The eggs should be collected daily and kept in a cool place where the contents will not evaporate too freely; if kept for some time they may be stored in loose bran. The first eggs are usually set under hens, while the last ones which the goose lays may be hatched either under hens or under the goose if she goes broody. If the eggs are not removed from the nest in which the goose is laying she will usually stop laying sooner than if they are taken away. The desire to sit can usually be broken up by confining her to a slat-bottom coop, with water to drink, but no feed, for 2 to 4 days. Some breeders prefer to raise all the goslings under hens, as geese sometimes become difficult to manage when allowed to hatch and rear their young. Hens used for hatching goose eggs

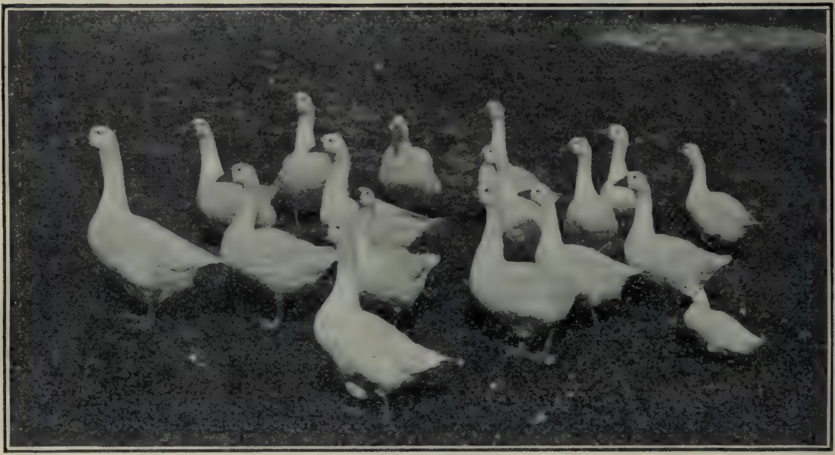

FIG. 7.—Flock of Embden geese.

must be dusted with insect powder and have good attention, as, in the case of geese, the period of incubation is longer than in that of fowls. Goose eggs may be hatched in incubators and the goslings successfully raised in brooders, although this is not a common practice.

The period of incubation of goose eggs varies from 28 to 30 days. Moisture should be added to the eggs after the first week if set under hens or in incubators; this is usually done by sprinkling the eggs or the nest with warm water. Incubators should be run at a temperature of 101.5° to 102.5° F., or about 1½° lower than for hens' eggs, and the eggs should be cooled longer. Four to six eggs are set under a hen and 10 to 13 under a goose. They may be tested about the tenth day, and those which are infertile or contain dead germs should be removed. They hatch slowly, especially under hens, and the goslings are usually removed as soon as hatched and kept in a warm place until the process is over, when they are put back under the hen or goose. Some breeders who hatch with both geese and hens give all the goslings to the geese. To keep a record of their age and breeding the web of the feet of the goslings should be punched when hatched. Hens with goslings may be confined to the coop and the goslings allowed to range. The latter, especially if the weather is cold, are not usually allowed to go into water until they are several days old. In mild weather the hens are allowed to brood the goslings for from 7 to 10 days, when the latter are able to take care of themselves. Some breeders assert that polliwogs in pools will poison young goslings unless the mash or drinking water has been slightly salted before the goslings are turned out to pasture.

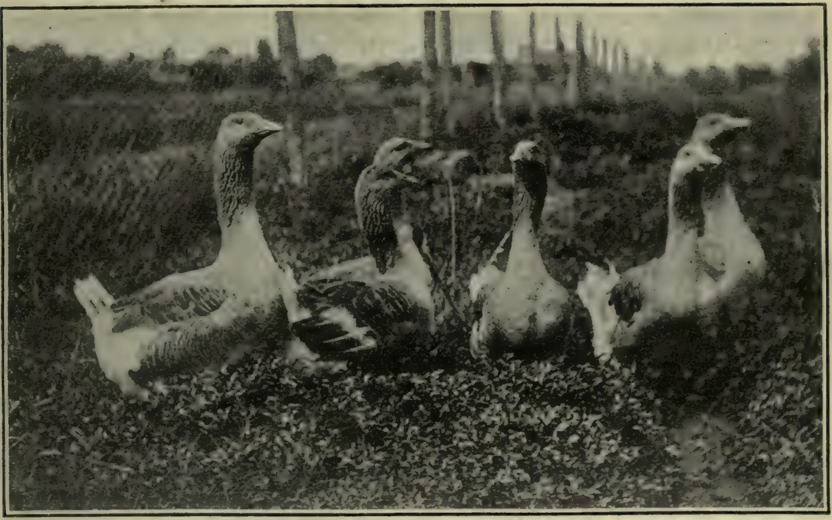

FIG. 8.—Flock of Toulouse geese.

Good-sized growing coops, with board floors, should be provided for the goslings, and they must be protected from their enemies. When on range young goslings need some attention, as they may get lost or caught in post holes and odd corners. Shade should be provided in hot weather. They should not be allowed to run with large animals, as they may be injured or killed.

FEEDING GEESE AND GOSLINGS.

Geese are generally raised where they have a good grass range or pasture, as they are good grazers, and, except during the winter months, usually pick up most of their living. The pasture may be supplemented with light feeds of the common or home-grown grains or wet mash daily, the necessity and quantity of this feed depending on the pasture. Goslings do not need feed until they are 24 to 36 hours old, when they should be fed any of the mashes recommended for chickens or ducklings, or a mash or dough of two-thirds shorts (middlings) and one-third corn meal, which can be made equal parts shorts and corn meal, and 5 per cent of beef scrap added after six weeks. Bread and milk is an excellent feed for young goslings. Fine grit or sharp sand should be provided for goslings by feeding 5 per cent of it in their mash or keeping it in a hopper before them. If the goslings are to be fattened, the ration should be changed to one-third shorts and two-thirds corn meal by weight, with 5 per cent of beef scrap added, while a feed of corn should be given at night. Most geese breeders do not confine their geese for fattening, but feed them freely a few weeks on a fattening ration before they are to be marketed. The geese may be confined for two or three weeks and fattened, but some green feed or vegetables should be added to the ration.

Adult geese may be fed for eggs about February 1 on a mash of 1 pound of corn meal, 1 of bran, 1 of middlings or low-grade flour, and 10 per cent of beef scrap, which is fed in the morning; equal parts corn and wheat, or corn alone, is fed at night. Grit and oyster shell should be kept before geese when they are laying and may be provided all the time to advantage. A constant supply of drinking water should be available for both goslings and geese. Drinking fountains or pans should be constructed so that neither goslings nor older stock can get their feet into the water. If the geese need extra feed when not laying, the beef scrap should be left out and the quantity of corn meal increased to three parts. Any available roughage, such as cut clover, hay, alfalfa, silage, cabbages, mangel-wurzel beets, or any waste vegetables should be added during the winter months, or whenever no good pasture is available. The time to feed for eggs depends upon the method of handling the geese, the section of the country, and the weather conditions, as goslings are usually hatched when the pastures are good.

PREPARING FOR MARKET.

Young geese, when fully feathered, are fattened in large numbers by buyers who make a specialty of this business. Several methods are used successfully in this special fattening of geese on a large scale. Six to eight geese are confined for three weeks in a pen and fed by hand five times daily on a mixture of 2 parts corn meal and 1 part of ground wheat and sifted ground oats, mixed with enough low-grade flour or "red dog" to make a stiff batter when water is added. This mixture is put through a sausage stuffer, cut into pieces 2 inches long and 1 inch thick, rolled in flour, and cooked like dumplings. This is fed warm, but after cooking the pieces are dipped in cold water to keep them from sticking together. Another method used is to confine the geese to large pens in a shed for from three to five weeks and keep whole corn in hoppers before them all the time, using oat straw for bedding. Considerable of the oat straw is eaten by the geese and serves as a good source of roughage. Corn silage may also be used for roughage.

A goose should be handled by its neck rather than by its legs and held with the back toward the attendant. In France and Germany a specialty is made of producing fattened goose livers, weighing from 12 to 32 ounces, by cramming geese which are about 6 months old on boiled corn. Some of these livers are preserved and called "pâtés de foie gras."

Before marketing the young geese the average farmer can feed advantageously a fattening ration either on grass range or confined to small yards, but it is doubtful whether it would pay him to confine them to individual or small pens and make a specialty of fattening unless he has a special market or retail trade for well-fattened stock. Young geese are in fair demand from June to January, while the demand is usually best at Thanksgiving and very good at Christmas. Ten-weeks-old goslings of the largest breeds of pure-bred geese weigh as much as 10 pounds if forced for rapid growth, and may often be marketed at this age to advantage. It is said to cost from 3 to 6 cents a pound to raise geese to 8 to 10 pounds weight.

Geese are usually killed and picked in the same manner as other kinds of poultry. They are generally stuck in the mouth with a long-bladed knife and then stunned by a blow on the back of the head with a short club. The wings are picked to the first joint, and the feathers are removed from the neck halfway to the head. The soft pinfeathers and fine down may be partly removed by rubbing the body with moistened hands or by shaving the skin. Geese may be steamed after killing by hanging on hooks in the top of a steam box or barrel, which can be made air-tight, and left there until the soft feathers on the breast come off easily. The length of time to leave them in the steam barrel depends on the flow of the steam, varying from one-half to two minutes. The wing and tail feathers are pulled before the geese are steamed. A good method for removing the down is to sprinkle powdered rosin over the body of the goose and dip it into hot water, which melts the rosin so that it and the down can be easily rubbed off, leaving the body clean. Geese may also be steamed by scalding slightly and wrapping the body tightly in burlap or cloth to allow the steam to work thoroughly through the feathers. Some markets prefer dry-picked geese, while in other markets no difference is made in the price of scalded or dry-picked geese.

After the geese are picked they are usually washed and put into ice water for 1 to 2 hours to cool and become plump. Many farmers sell their geese alive. When dressed poultry is shipped from the farm it should be first cooled and then packed in clean containers, which can be packed in ice and shipped by express in such a way that the poultry does not come in contact with the ice or drippings. It costs about 11 cents each to pick geese. Goose feathers sell at from 30 cents to $1 a pound and should be carefully saved and dried. White are worth considerably more than mixed-colored feathers. Scalded feathers are not usually considered of any value, but steamed ones are as good as the dry-picked.

Nearly all breeders of geese in the South and many in the Middle West and the North pluck the feathers from the live geese at some time prior to molting. Some pick as often as every six weeks during the spring, summer, and early fall, while others pick only once or twice a year, either in the spring or both in the spring and in the fall. Feathers are considered ripe for picking when the quills appear dry and do not contain blood. The average yearly production of feathers per goose is about one and one-tenth pounds. This practice of plucking geese, however, is considered by many breeders to be cruel and injurious. Geese should not be picked during the breeding season. The demand for goose feathers and the practice of plucking geese appear to be decreasing, while more attention is given to the production of young geese for market.

REPORTS FROM BREEDERS.

About 300 replies were received from a list of questions sent to breeders of geese in all parts of this country where geese are commonly raised. These data have been divided into two sets, one covering sections in the Southeastern States as far north as the Ohio River and as far west as Oklahoma, while the other sections (Northeastern, Central, and Pacific Coast) make up the other group.

REPORTS FROM THE SOUTH.

Small common geese were kept very largely in the Southern States, while only a few breeders kept pure-bred geese, of which the Toulouse, Embden, Chinese, African, and Canada were the most popular, in this order. Almost all these breeders picked feathers from the live geese once or several times during the year, some farmers picking the feathers as often as once in six weeks. Many reported keeping the geese largely for the production of feathers and did not consider them profitable as market poultry. During the winter about one-third provided some shelter, such as an open shed or a barn, but very few had houses used only by the geese.

The averages for these Southern States showed that the gander weighed 11.2 pounds, the goose 10.7 pounds, and the young goose 7.8 pounds. The geese produced 1.15 pounds of feathers, which were valued at 54 cents a pound. An average yield of 16.3 eggs was obtained, of which about two-thirds were hatched under geese and the rest under hens. The breeding stock were mated either in pairs or in trios of one gander with two geese, with an average mating of two males to three females. Three-fourths of the geese were marketed alive at an average price of 76 cents, giving a profit of 49 cents. Geese sold for breeding purposes were not included in averaging the selling price and the profit. The selling price and the profit reported by farmers who produced geese only or largely for sale as breeding stock were considerably greater than those reported for market stock.

REPORTS FROM THE NORTH AND WEST.

Pure-bred geese were kept very largely in the Northern, Central, and Pacific Coast States, as shown by the reports, although some common geese were reported from most of them. The Toulouse and Embden were by far the most popular breeds, while the other breeds ranked in the following order: Chinese, African, and Canada. Less than half of the breeders in those States reported that they picked feathers from the live geese, the practice being more common and picking more frequent in the States farthest south, although it was reported from all the States. Most breeders picked the geese only once or twice, and then only during warm weather, but a few reported picking several times during the year. More than three-fourths of the breeders provided shelter for the geese during the winter, and many had houses used only by the geese.

In the averages for these States the gander weighed 17.7, the goose 15.2, and the young goose 13.2 pounds, which is several pounds heavier, in each class, than is shown in the reports from Southern States. The geese produced an average of 1.11 pounds of feathers, valued at 69 cents a pound. The average egg production was 26.7, of which slightly more than half were hatched under hens. Apparently hens were used much more commonly for hatching than in the South, on account of the higher egg yield and the greater weight of the geese. With larger egg yields part of the eggs would have to be hatched under hens or in incubators, while some breeders who keep large, heavy geese prefer to use hens for hatching. Most of the geese were mated in pairs, some in trios, with an average of four males to nine females. Three-fifths of the geese were marketed alive and brought an average price of $1.82 and a profit of $1.16 each.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 768 NOVEMBER 18, 1916

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

DWARF BROOM CORNS.

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Scientific Assistant in Grain-Sorghum and Broom-Corn Investigations.

CONTENTS.

Page.
Introduction 1
Climatic adaptation of broom corn 1
Varieties 2
Growing the crop 3
  Preparing the seed bed 3
  Good seed 5
  Sowing the seed 7
  Cultivating broom corn 8
  Harvesting the brush 8
  Thrashing 9
  Curing 10
Preparing for market 12
  Grading 12
  Baling 13
  Storing 13
Diseases 14
  Treatment for smut 14
Profit and loss 14
  Cost of production 14
  Marketing 15
  Yield 15
  Use and value of the stover 15

INTRODUCTION.

Broom corn probably was derived from some sorgo with a loose, open head. In Italy the growing of a sorgo of this sort for making clothes brushes dates back more than 350 years. Broom corn has been grown in the United States for at least 118 years, or since 1798.

Sixty years ago the States of New York and Virginia led in the growing of this crop. Then the center of production moved slowly westward to Illinois and the adjacent States. During all of this time most of the crop was of the tall-growing Standard variety. Following this the Dwarf broom corn was produced and the center of production again moved westward. The leading States in broom-corn production are now Oklahoma, Kansas, and Texas, in the order named (fig. 1). Most of the broom corn grown in these and adjacent States is of the Dwarf variety.

CLIMATIC ADAPTATION OF BROOM CORN.

In its requirements broom corn differs little from the other sorghums, making its best growth in a warm, sunny climate. It is

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both drought resistant and drought evasive. Like all sorghums, it makes better use of a limited supply of water than does corn. Like corn, its growth is checked by cool nights, even when followed by days of moderate or intense heat. While broom corn may be grown in almost every State in this country it is not commercially profitable except under favorable conditions.

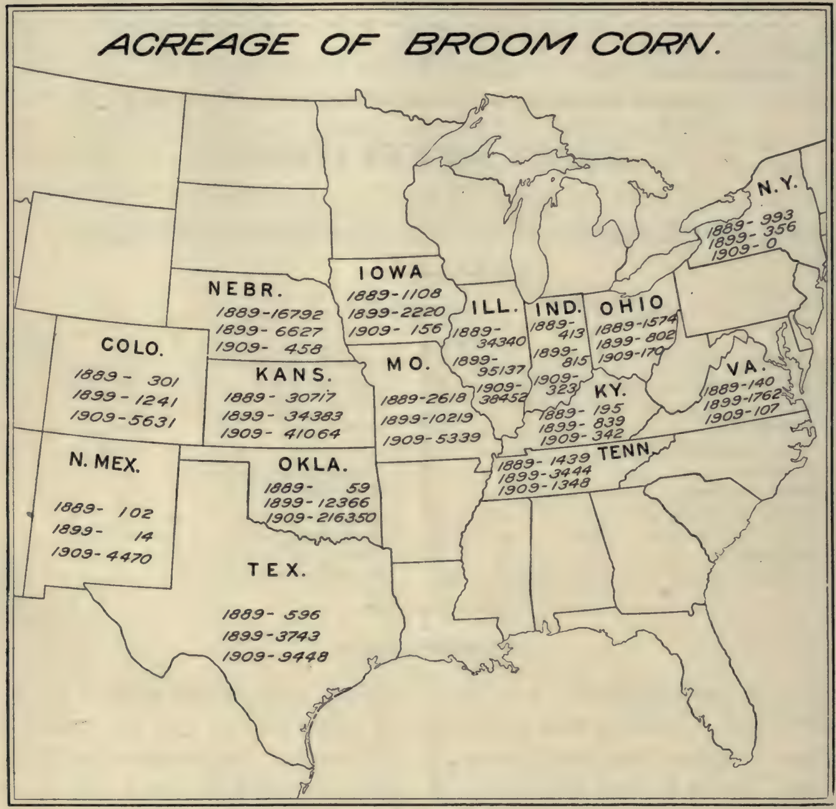
ACREAGE OF BROOM CORN.
N.Y. 1889- 993 1899- 356 1909- 0
IOWA 1889-1108 1899-2220 1909- 156
NEBR. 1889-16792 1899- 6627 1909- 458
ILL. 1889- 34340 1899- 95137 1909- 38452
IND. 1889- 413 1899- 815 1909- 323
OHIO 1889-1574 1899- 802 1909-170
COLO. 1889- 301 1899- 1241 1909-5631
KANS. 1889- 30717 1899- 34383 1909- 41064
MO. 1889-2618 1899-10219 1909-5339
KY. 1889- 195 1899- 839 1909- 342
VA. 1889-140 1899-1762 1909-107
TENN. 1889- 1439 1899-3444 1909-1348
N. MEX. 1889- 102 1899- 14 1909- 4470
OKLA. 1889- 59 1899- 12366 1909- 216350
TEX. 1889- 596 1899-3743 1909-9448

FIG. 1.—Outline map of the Central and Eastern States, showing the acreage of broom corn in each State in the years 1889, 1899, and 1909.

Broom corn is especially suited in many ways to the southern section of the Great Plains area. It supplies the urgent need of the settler for a dependable cash crop on his cheap, new land. It can be grown successfully in spite of the light rainfall and the droughts that mark the climate of that section. The usually dry, sunny weather at and following harvest is favorable for curing the brush, so that it retains its natural green color.

VARIETIES.

There are only three well-marked varieties of broom corn under cultivation in this country. These are the Dwarf, Acme (Dwarf Standard), and Standard. Numerous varietal names are in use, but they do not represent distinct varieties. Of the three named above the first two are of dwarf size, while the third is tall.

Among the different names that have been applied to the Dwarf broom corn are California Golden Dwarf, Dwarf, Dwarf Evergreen, and Oklahoma Dwarf. The varietal name is not very important. What the grower wants to know is whether he is getting Dwarf, Acme (Dwarf Standard), or Standard broom corn.

Dwarf broom corn makes up about two-thirds of the total broom-corn crop of this country. It does not grow as tall as the Standard, has shorter brush, and the method of harvesting is different. It grows from 4 to 5 or 6 feet in height, according to soil, season, and altitude. The brush varies in length from 15 to 20 or sometimes 24 inches. The fiber is usually much finer in texture than that of the Standard. The peduncle (main stem of the head, or brush) is less firmly attached to the upper node (joint), which allows the brush to be harvested by pulling or "jerking."

The brush of this variety is of the highest value when it is suitable for the manufacture of whisk brooms and brushes, which require a short, fine fiber of good quality. Such brush always brings the top market price. In large, heavy brooms it can be used only for the centers, as it is too short for the outside layers. A lot of broom corn is said to be self-working when entire brooms can be made from it. To be self-working the brush must contain a large percentage of hurl, or fiber 18 or more inches long, suitable for use on the outer layers of the broom.

The Acme (Dwarf Standard) is a variety developed recently from a sport of the Standard broom corn. It resembles the Standard in length of brush and the Dwarf in height. The method of harvesting is the same as for the Dwarf. These characters make it adapted to the southern Plains, where the Dwarf broom corn is grown so extensively. Its chief advantage over the Dwarf variety is the longer brush, which is self-working for ordinary brooms. This variety has been developed within the last few years by the United States Department of Agriculture and is not yet grown commercially. A plat of the Acme variety is shown in figure 2.

GROWING THE CROP.

The cultural requirements of broom corn are practically the same as those of milo, kafir, and corn. Different treatment is required in different sections and seasons and on different soils in the same section.

PREPARING THE SEED BED.

The time and depth of plowing depend largely upon the nature of the soil and the quantity of the winter rainfall. Fall plowing is generally preferable to spring plowing. Heavy soils in districts of considerable winter precipitation will catch more moisture if plowed in the fall and left rough over winter.

Whether the land is plowed in the fall or in the spring, it should be worked with the disk harrow and smoothing harrow into a deep, uniform seed bed. This permits sowing the seeds at a uniform depth. The young plants then emerge at about the same time and the brush develops uniformly.

In the southern section of the Great Plains area listing instead of plowing is common. The lister is essentially a plow with a double moldboard. It cuts a deep, wide furrow, turning the soil on to the unplowed land on either side. Listing differs from plowing, therefore, in that the furrow just made is not filled at the next round. The furrows are from 2½ to 3½ feet apart. The land is thus left in alternate furrows and unbroken ridges, the loose soil from the furrows being piled on top of the ridges.

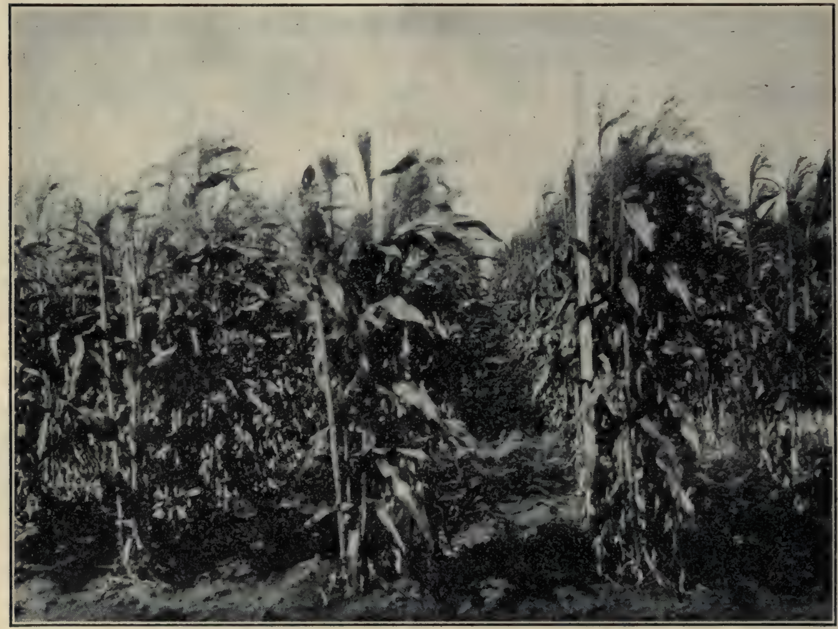

FIG. 2.—Plat of Acme (Dwarf Standard) broom corn, 6 to 7 feet tall.

The listing should be done in the fall and the land left over winter in this rough condition. Since the prevailing winds are from the south to southwest or the northwest to north, listing is done east and west where possible. The winter snowfall is held in the lister furrows and thus distributed over the entire field instead of drifting into the fence rows or blowing entirely off the field. When light soils begin to blow in March and April the only effect on listed ground is to move the soil from the ridges into the furrows.

Preparing the seed bed in the spring is done in three ways: (1) By relisting, which is done by breaking the ridges with a lister having a seeder attached, thus listing and sowing the crop at the same time;

(2) by working down the lister ridges with a disk harrow; or (3) by relisting before using the disk harrow to work down the ridges. In either the second or third cases the crop may be surface sown.

GOOD SEED.

The first requisite to the production of good broom corn is good seed. A uniform stand and a uniform crop are necessary to produce the maximum yield of high-quality brush. These can be obtained only by using pure seed of strong vitality. In obtaining seed for sowing one should know not only the quality of the seed, but also the quality of brush from which the seed was thrashed. Broom corn crosses readily with other forms of sorghum, including sorgo, durra, milo, feterita, kafir, etc. These are commonly grown throughout the southern part of the Great Plains area. Seed from such hybrids produces worthless brush. Out of 34 lots of commercial seed grown recently, eight were found to be badly hybridized.

There are three common sources from which seed is obtained: (1) From growers who make a business of growing the seed for sale, (2) from the piles of seed which accumulate at the broom-corn thrashers, and (3) from home-grown seed from the field or seed plat of the grower or his neighbor. There are serious objections to the seed derived from some of these three sources and some objections to the supply now obtained from any of them.

SEED FROM PRIVATE GROWERS.

The seed grown in large quantities by private growers who specialize in broom corn is usually of good quality. Most of these growers, however, are located in States having a humid climate. This seed is not well suited to the dry-land conditions of a large part of the southern Plains area. The broom-corn growers in the drier western parts of Kansas, Oklahoma, and Texas can not get the best results by importing seed from the more humid districts farther east. Western growers should grow their own seed. Each farmer should have his own seed plat or else obtain his seed from some one in his locality who specializes along this line.

SEED FROM BROOM-CORN THRASHERS.

Good seed can not be obtained from broom-corn thrashers. The brush is harvested somewhere between the flowering and early dough stages. The greater part of such so-called seed is immature and will not germinate.

Even if a large percentage of the immature seed is removed by the vigorous use of the fanning mill, that which remains is not desirable for sowing. It is likely to be a mixture of the Dwarf and the Standard varieties. The seed also will have come from brush of all grades. Some may have come from the fine-fibered, short brush; some from heavy, coarse brush; some from tree-top, or spiky brush; and still another part from curly or twisted brush.

One of the most serious objections to seed from the thrasher is the likelihood of getting seed from hybrid plants. Milo, kafir, and sorgo are grown commonly in the districts producing the Dwarf broom corn. Hybrids occur very abundantly. No effect on the plant is seen the first year; that is, in the season when the cross occurs. The seed from these hybrid plants, however, will produce a great mixture of forms, mostly worthless. No matter how much care is taken in cleaning and grading the seed, these hybrid seeds will not be removed.

The likelihood of getting smut-infested seed is very great when seed is obtained from unknown or mixed sources. When smutted seed is sown, unless it is first treated to destroy the disease, there is certain to be a large percentage of smutted brush in the resulting crop. This causes heavy loss to the grower, since smutted brush is of little or no value. It also infests the seed on healthy brush and endangers future crops. The kernel smut, which is the common smut of broom corn, is easily and cheaply destroyed by the formalin or the modified hot-water treatment of the seed. There is no reason for allowing it to reduce quality and profit.

Formalin treatment for kernel smut.—Mix 1 pound of commercial formalin with 30 gallons of water in a tub or barrel. Put the seed in sacks and soak in this solution for one hour, stirring it occasionally. Then drain the sacks and spread the seed on a clean floor or canvas to dry. Clean the floor or canvas and the sacks into which the seed is put with the solution. The seed will be infected again if any untreated smut spores touch it.

The solution may be used also as a spray. In this case spread the seed on a clean floor or canvas and sprinkle with the solution. The seeds must be stirred until all of them are wet. Shovel the seeds into a pile and leave over night covered with a treated canvas to keep in the fumes. In the morning spread out to dry. The soaking or immersion method is more thorough, though perhaps not as convenient as the sprinkling method.

SEED FROM A HOME SEED PLAT.

The home seed plat can be made the ideal place for producing broom-corn seed. The grower can be absolutely sure of the quality of his seed from this source. If the proper precautions are followed, he has seed as good as that produced by any commercial grower.

The surest way to get results is to sow a small plat on one side of the main field with the purest seed obtainable. As the plants approach the heading stage, all which are hybrids or not true to the variety grown, as indicated by different heights, sizes, shapes, or colors, should be removed before they can scatter pollen. As the brush begins to emerge from the boot, the remaining plants of desirable type should be inspected daily. All spiky brush having a strongly developed central stem should be removed before it flowers and cross-fertilizes the desirable brush. If this work is well done the first year, much less time will be required in the second and succeeding years.

SOWING THE SEED.

The chief problems in sowing are when and how much to sow and how it should be done.

WHEN TO SOW.

Sowing broom corn begins in the southeastern part of Texas as early as April 1. In the southeastern part of Oklahoma it begins about April 15. In western Oklahoma, the Panhandle of Texas, and southwestern Kansas sowing begins about May 10 and continues for about two weeks.

The time differs with the locality and even in the same locality. The seed will not germinate readily in a cold soil, and if sowing is done too early a poor stand may result. On the other hand, late seeding may allow injury from summer drought. Usually the crop is sown about two weeks later than the average date for planting corn in any given locality.

HOW MUCH TO SOW.

Experiments made at the Woodward Field Station, Woodward, Okla., show that one plant every 6 or 8 inches in the row is about right where the rows are 3½ feet apart. This will be true of other localities with similar conditions. Thinner stands may be necessary under very dry conditions. To obtain a stand at any stated rate a thicker sowing will have to be made, as not all of the seeds will grow. Two pounds of good seed are sufficient to sow an acre in dry sections.

The rate of seeding depends somewhat upon the available moisture and the fertility of the soil. On moist, rich soils the crop should be sown at a heavier rate than on poor soils or in dry sections. Thin stands on rich soils tend to produce long, coarse brush. Too thick stands on poor soils or in dry sections produce short brush, or in extreme cases fail to produce brush at all.

METHOD OF SOWING.

Broom corn may be surface sown with an ordinary corn drill or listed with a lister drill. That method should be used which experience with similar crops has proved best for any given locality. Listing is preferable in soils subject to blowing. The young plants at the bottom of the lister furrow are protected from the cutting action of blowing sand or soil grains. In surface-sown crops a complete loss sometimes occurs from this cause.

Either an ordinary corn drill or a lister drill may be fitted with special plates for sowing broom corn. These plates can usually be obtained from the manufacturers or the local implement house. Blank plates may be obtained and drilled by a blacksmith or by the farmer himself. The number of holes in the plate required to sow a given rate depends to some extent on the speed adjustments of the corn drill. This adjustment differs in the planters of different makes. The speed adjustment of the planter to be used should be learned. Then the number of holes in the plate required for a given rate can be determined. The holes should be three-sixteenths of an inch in diameter and slightly countersunk on the under side, so that the seed will not wedge fast in the hole.

CULTIVATING BROOM CORN.

Cultivation should begin early and be repeated as needed while the plants are small, as they make slow growth and are easily choked by weeds. When the crop is surface sown, a spike-tooth harrow is an efficient tool for the first and second cultivations. Later cultivations are made with an ordinary corn cultivator.

The first harrowing should be given while the seed is germinating, so that no surface crust will be formed to keep the plants from getting out of the ground. The second harrowing should be given just before the plants are large enough to be worked satisfactorily with the cultivator. The listed crop must be cultivated with a lister cultivator. In the first cultivation the disks are set to turn the soil away from the young plants. After this the disks are reversed, to throw the soil toward the plants, thus filling the furrows and leveling the ridges as the cultivations continue.

HARVESTING THE BRUSH.

The value of the brush depends greatly on the care used in harvesting.

WHEN TO HARVEST.

To obtain brush of the best quality, harvesting should be done early. It may be at any time from the beginning of blooming until the seed is in the early dough stage. The exact time depends very largely upon the development of the fiber. The strength of the fiber increases until the natural pea-green color extends from the tip to the base and from the outside to the center of the head. After this time the brush becomes more brittle as the ripening progresses. A large part of the head in the Dwarf and Acme varieties remains inclosed in the leaf sheath, or boot. The condition of the base of the brush can not be judged by noticing only the exposed tip. The base of a number of heads should therefore be examined in order to make certain of the condition of the brush. If harvesting takes place before the green color has developed throughout the base of the brush, the result is a weak base and poor quality.

When the crop is grown for seed, the brush is not harvested until after the seed is fully mature. Ripe brush, however, is of little value for making brooms. The value of such brush depends upon the climatic conditions previous to harvest and upon the care given the brush after the seed is removed. If ripe brush is not discolored by wet weather but has the natural yellow color of mature brush, it commands about half the price of good brush. It should be cared for and baled the same as the good brush.

METHODS OF HARVESTING.

There are two methods of harvesting broom corn, due to differences in the height of the plants and the strength of the peduncle where it is attached to the upper joint. The Standard broom corn grows so tall that it must be bent over, or tabled, to bring the brush within reach so that it can be cut off.

The brush from Dwarf and Acme broom corns is harvested by pulling or jerking the heads from the standing stalks. Walking down the standing row, the operator takes hold of the sheath, or boot, with one hand and with the other catches the top of the brush and gives it a quick downward and outward jerk. This breaks it from the stalk at the upper joint, leaving about 6 inches of stem with the brush. As the brush is harvested it is placed in piles, either on the ground between the rows or between the stalks in the row. This method of placing the brush is shown in figure 3. The latter method is preferred, as dirt is less likely to be splashed on the brush in case of rain before it is removed to the thrasher or to the rick.

THRASHING.

Removing the seed from the brush is variously termed thrashing, seeding, or scraping. The machine used is constructed especially for this purpose. It consists essentially of two cylinders, one placed above the other, revolving rapidly in opposite directions. The surfaces of both are set with teeth or spikes. In thrashing broom corn, only the part of the head which contains seed passes into the cylinders.

There are now in common use two different makes of these thrashers, one hand fed and the other self fed. In thrashing with the hand-fed machine the feeder stands directly in front of the cylinders. The brush is grasped firmly by the stem at the base and the tip inserted between the cylinders and held there until all the seed is removed. The brush is then withdrawn.

In the self-feeding thrasher the heads are carried to the cylinders by a sprocket belt passing in front of the cylinders and parallel to them. This belt holds the brush firmly by the stems and is so adjusted that only the seed-bearing tip passes between the cylinders. The seed is stripped from the brush as it passes along to be deposited on a table beyond the cylinders. This thrasher has a much larger capacity than those fed by hand.

The small hand-fed thrasher does as good work as the large one and does not require so many men to operate it. Where there is a large quantity of brush to be thrashed, however, and the required help is available, the larger machine is preferable. Time saved in thrashing shortens the risk of exposure to damage by wet weather.

CURING.

The value of the brush is frequently determined in the process of curing. To a large extent, color and condition govern the price of broom corn. In order that the brush may retain its fresh green color, it must be cured rapidly and not exposed to strong light. There are many methods of curing now in common use. Some of these are not desirable, because a large percentage of damaged brush results.

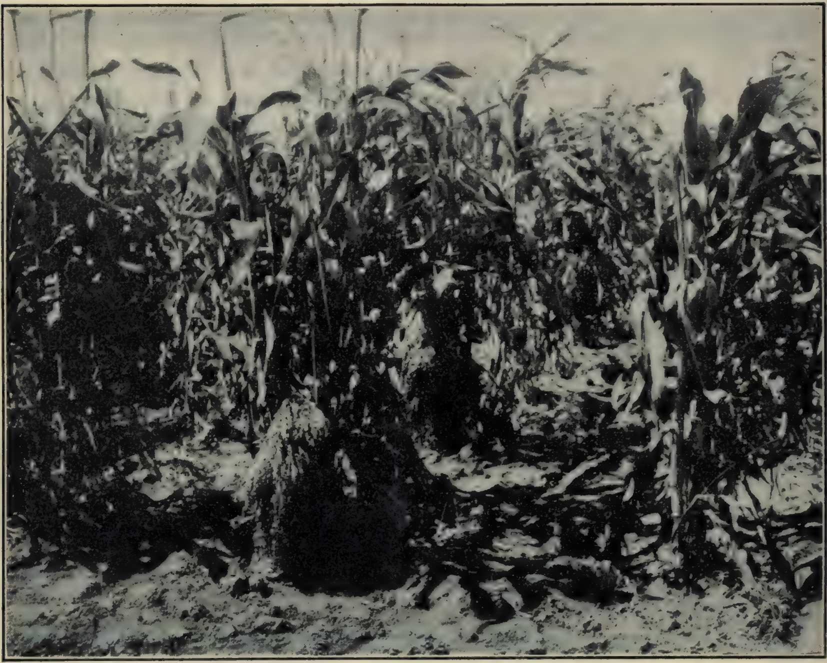

FIG. 3.—Small piles of brush placed between the broom-corn stalks to cure.

SHED CURING.

The best known method of curing is in a shed built especially for this purpose. A curing shed need not necessarily be expensive. About 1 cubic foot of space is required for each 2 pounds of cured brush. A shed 10 feet high, 16 feet wide, and 24 feet long will contain ample space for green brush which will make about 3½ tons after curing. This is equal to the average yield of about 35 acres of Dwarf broom corn in western Oklahoma, Kansas, or Texas.

A curing shed consists chiefly of a framework of heavy studding 10 feet high to the plate, supporting a roof with widely projecting eaves. The gables are sheeted, but the sides and ends usually are left open to permit free circulation of air. Sometimes the end or side in the direction from which rains usually come is sheeted, also to protect the brush. The roof and sheeting may be made of galvanized iron, lumber, or other suitable material. The eaves should project 4 to 6 feet beyond the framework, to shade the brush from direct sunlight and protect it from rain. In many cases the grower cures his brush in a wagon shed or cattle shed, open on one or two sides. The brush occupies it but a few weeks in summer and leaves it available for other purposes the remainder of the year.

The brush is cured in shallow layers spread on a series of slats. When the shed is 16 feet wide and the posts or studs are set 8 feet apart, the interior is readily separated into sections 8 feet square by setting a row of posts in the center, exactly opposite the studding. Strips of board 1 inch thick, 2 inches wide, and 16 feet long are nailed across the shed on the posts. The first strip is put down near the ground, and the strips are placed 6 inches apart from center to center until the plate is reached. The shelves for the brush are made by laying 2-inch slats in pairs lengthwise of the shed and resting on the cross slats. The members of each pair are just far enough apart to support the brush. These are put in place only as fast as needed while filling the shed.

Filling may be done from one side only, in which case the first layer is placed at the bottom on the opposite side. The next layer is placed above the first, and so on. If filling is done from both sides, the first layer is placed at the bottom in the middle. By these methods no space is wasted in passageways inside the shed.

The brush is spread evenly 2 or 3 inches deep upon the two slats. The brush will not dry quickly if placed more than 3 inches deep on the shelves. It may also become moldy, losing its green color and becoming brittle.

All brush harvested in any one day should be hauled to the shed before night. The following morning this brush should be thrashed and placed on the shelves to dry. When the brush is handled in this manner there will be no loss from weather-stained or bleached brush. By this method the thrashing takes place while the brush is green, and fewer fine tips of the fiber are torn off with the seed than when thrashing is done after the brush is cured.

RICK CURING.

Rick curing is now practiced to a very large extent where Dwarf broom corn is grown. This method is next best to shed curing, but the loss from damaged brush often is considerable. In many cases the difference in price in favor of shed-cured brush is so large that the loss on a few tons of rick-cured brush will pay the cost of the curing shed. This is especially true when damp and rainy weather occurs during the time the brush is curing.

In rick curing, the brush is dropped in small piles between the stalks in the row as it is jerked. Each pile contains two or three handfuls. Here it remains for several days, until it is about half cured. It is then hauled and placed in ricks. In these it is left until thoroughly dry, when it is ready to be thrashed and baled. The ricks are made narrow, placing the heads with tops out and butts in, lapping the middles just enough to shed water in case of rain. The ricks should be built 4 or 5 feet high and as long as desired (fig. 4). They are covered with broom-corn stalks or anything else that will shed rain and shield the brush from the direct rays of the sun. When cured in a rick, thrashing must not be done until after the brush is cured, as the brush without the seed packs so closely and excludes the air to such an extent that it "stack burns." The brush should not be baled until it is so dry that the butts will break off when bent back and forth. The thrashing and baling of rick-cured broom corn are shown in figure 5.

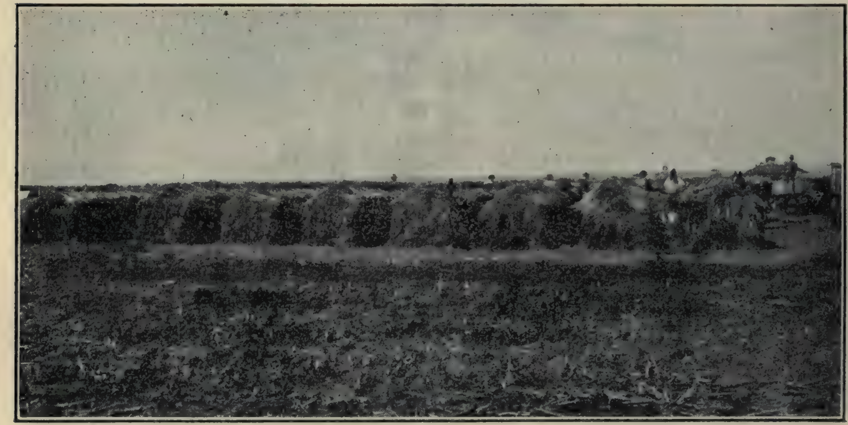

FIG. 4.—Rick-cured broom corn ready for the thrasher.

PREPARING FOR MARKET.

The market value of the brush depends to a large degree upon the care with which grading, baling, and storing are done. Much of the season's profit may be lost after the crop is cured.

GRADING.

A common source of loss to the broom-corn grower is the prevalent practice of baling the crop without grading. Everything harvested in the field is put together to form the bale, which is the unit in the selling transaction. Where good and poor brush are mixed, the buyer must always be on the safe side. The percentage of poor brush will be estimated a little higher than appearances indicate. The price paid under such circumstances usually is less than the average price the good brush and poor brush would have brought if baled separately. The grower will be repaid for the time and labor of grading his brush and baling each grade separately. Crooked heads, heads with twisted or kinky fiber, and those containing a large center stem are of poor quality and should be separated from the good brush. Grading can be done conveniently either when the brush is being taken from the field or after it is thrashed and just before the baling is done.

BALING.

All commodities offered for sale command a better price when put up in neat and attractive parcels. This is true with broom corn. The bales should have a neat appearance when finished, with all the wires tight and securely fastened (fig. 6). To accomplish this it is essential that the heads be laid straight in the baler. The brush should be taken up in small armfuls and butted against a board, so that all the butts are even. The butts then should be placed firmly against the end of the baler. The butts of one armful are placed against one end and those of the next armful against the other end. This process is continued until the baler is full. Pressure is then applied, the bale pressed into shape, and the wires fastened. A good square bale may be made by filling in this way if the bale is pressed tightly and the wires properly adjusted to hold it in shape.

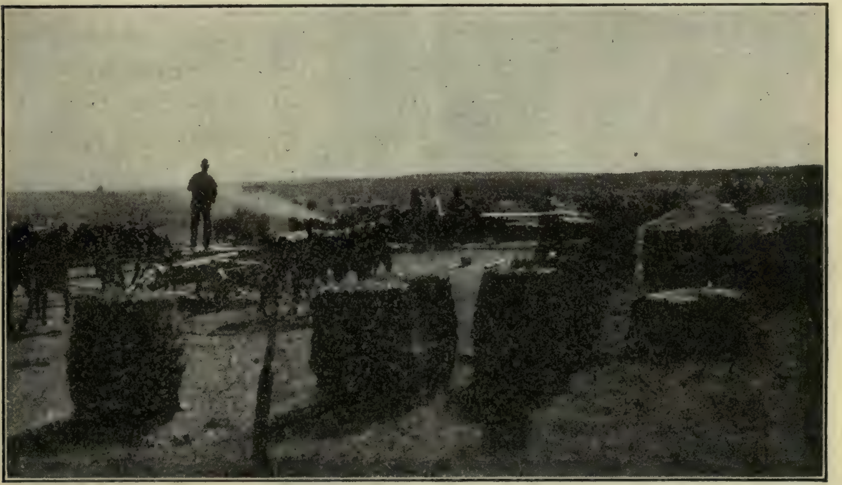

FIG. 5.—Thrashing and baling 100 acres of rick-cured broom corn in Oklahoma.

STORING.

If the bales are not sold directly after baling they should be stored in a dry, dark place for protection against the weather and sunlight. Otherwise, the outside of the bales will be weather stained or bleached by the sun and will not command as high a price as if kept in good condition.

DISEASES.

Broom corn, like other sorghums, is affected by two kinds of smut, the kernel smut[1] and the head smut.[2]

The kernel smut is much the more common of the two and may cause great loss if not kept under control. This smut is easily recognized. The head retains its usual form and nearly its usual appearance, but the kernels are replaced by black masses of smut spores. The fiber is more brittle than that from noninfested heads.

Head smut affects the plant in quite a different way. The whole head is converted into a large smut mass covered by a whitish membrane, which soon bursts and sets free the black mass of spores. When this smut occurs the brush is an entire loss.

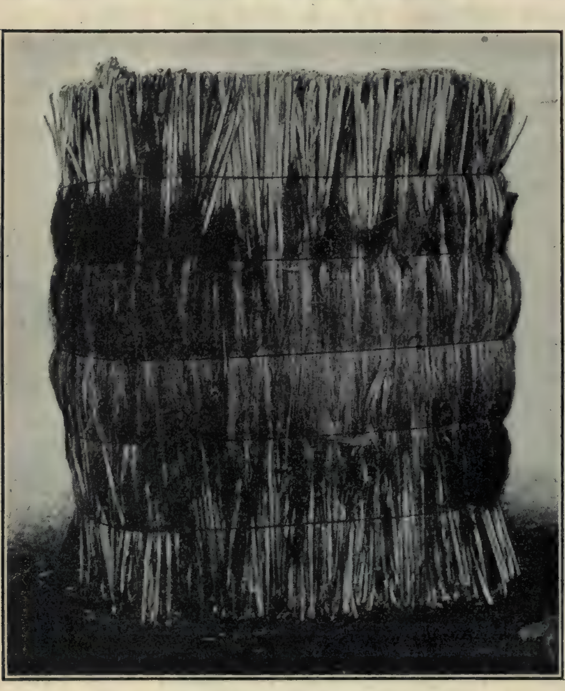

FIG. 6.—A well-made bale of broom corn.

TREATMENT FOR SMUT.

Kernel smut can be entirely destroyed by treating the seed. Brief directions for applying the formalin treatment have been given in the discussion of good seed (p. 6).

There is no known seed treatment effective against head smut. It is not abundant except in small districts. If possible, keep it off the farm. When it is present the plants should be gathered and burned before the spores are scattered by the wind.

PROFIT AND LOSS.

The profit or loss on a broom-corn crop depends largely upon the cost of production, the yield, and the market price of the brush. It is an expensive crop to produce, because of the large amount of hand labor and the special machinery required to care for the brush properly.

COST OF PRODUCTION.

The cost of production varies in different localities, due to differences in land values and in the cost of labor. It costs little, if any, more in any given locality, however, to produce a good grade of brush than a poor one. Successful growers in Kansas and in Oklahoma have placed the cost at from $35 to $50 a ton. The cost of the special machinery, such as the thrasher and the baler, may be much reduced to each grower if purchased by several growers in common. The labor problem may also be partly solved by combining forces when labor is scarce.

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[1] *Sphacelotheca sorghi.*

[2] *Sphacelotheca reiliana.*

MARKETING.

Broom corn is a crop in the growing of which community cooperation is greatly needed, for the reasons already mentioned. There are still other reasons. Where grown extensively, the brush can be shipped in carload lots, which makes a saving in freight rates. The brush may be marketed to better advantage in a community where much of it is grown, for the manufacturers are more likely to send an experienced buyer into such a community. It is possible, too, for a community to grow a uniform grade of brush which will be recognized and sought by the manufacturer.

Good brush always brings a much higher price than poor brush. The prices of all grades vary widely in different years and sometimes in the same season, depending upon the supply. When the production is large and much of the crop is of poor quality the prices drop very low on all grades. Under such conditions the poorer grades may sell for $20 or $25 a ton, while the better grades bring from $50 to $60 a ton. When there is a scarcity prices are much higher, sometimes reaching $250 per ton for the best quality of brush. Normally, the market price for good brush ranges from $75 to $100 per ton. Practically all the brush is consumed in this country, and the price is therefore governed by the home market.

YIELD.

During the last 30 years more than 93 per cent of the brush produced in the United States has been grown in 16 States. The acre yields in each of these States, taken from the United States Census, for the years 1889, 1899, and 1909, with the average yields in the three years, are shown graphically in figure 7. It will be noted that Oklahoma has the lowest average yield; yet that State produced 21,371 tons of brush in 1909, which was about 55 per cent of the total crop in that year. The total production in each of the three years was 19,278, 45,475, and 39,479 tons, respectively.

USE AND VALUE OF THE STOVER.

Broom-corn stover consists of the stalks and leaves remaining after the brush is removed. It is easily harvested with a row binder, or it may be cut with a mowing machine. It may be used either as silage or dry roughage, and may also be pastured. Broom corn as stover is thought to be worth about as much as sorghum stover or corn stover. It is, of course, worth much less than kafir fodder or corn fodder, because these contain grain in addition to the stalks and leaves. The value of broom-corn stover from which the brush has been pulled at the right period is estimated to be $1 to $3 per acre, depending upon the quality and quantity.

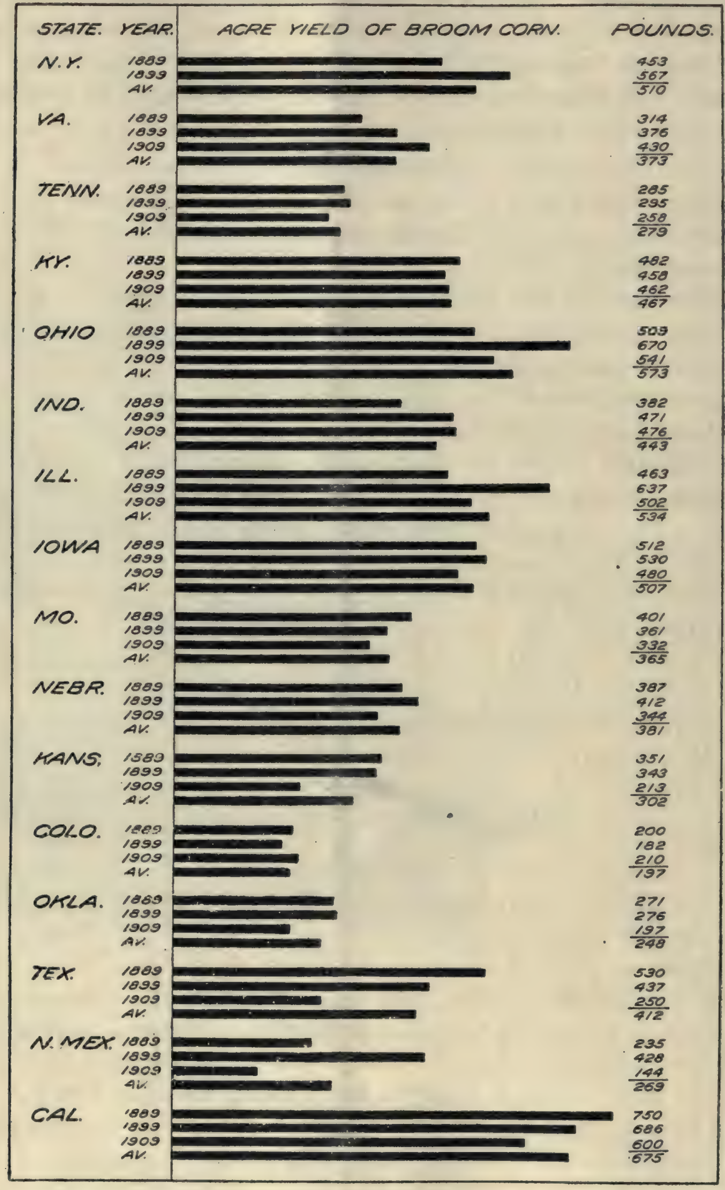

FIG. 7.—Diagram showing the acre yields, in pounds of brush, in the 16 States growing broom corn in the years 1889, 1899, and 1909, and the average yields for the three years.

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GROWING GRAIN ON SOUTHERN IDAHO DRY FARMS

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FARMERS' BULLETIN 769

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. October, 1916

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GROWING GRAIN ON SOUTHERN IDAHO DRY FARMS.

CONTENTS.

Page.
Introduction 3
The Snake River basin 4
Dry-farming machinery 6
Good seed 13
Seed-bed preparation 14
Cereal crops 16
Wheat 16
Oats 21
Barley 22
Minor grain crops 22

INTRODUCTION.

Dry-land farming is comparatively new in southern Idaho. Sagebrush land is continually being made ready for the plow, and the area in dry farms is rapidly increasing. As Idaho is one of the few States in which land is still available for entry under the homestead act, people are attracted from nearly all walks of life and from many sections of the United States.

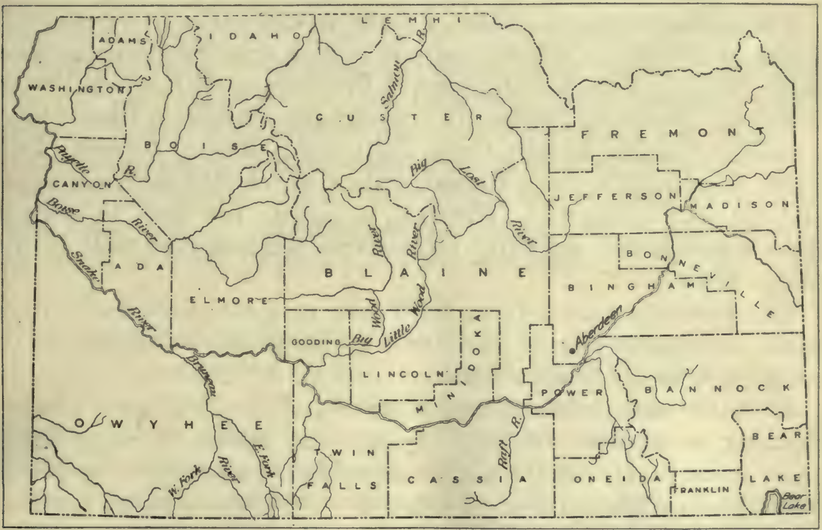

FIG. 1.—Map of southern Idaho, showing the Snake River basin and the location of the Aberdeen Branch Experiment Station.

These people bring to Idaho different systems of farming, different varieties of crops, and different modes of living. While many of them succeed, many fail in dry farming. These settlers need reliable information which will enable them to make homes on the dry farms as quickly and at as little expense as possible. Much of the available information on dry farming is in such form that it can not be used to advantage.

For these reasons a conservative, up-to-date bulletin on dry farming in southern Idaho is greatly needed. It is hoped that the present paper may meet this requirement. The results obtained at the Aberdeen Branch Experiment Station[1] since its establishment in 1911 are used as a basis. Facts from the experiences of many of the most successful dry farmers in the State and from bulletins published in near-by States are also included.

The principal crops grown on the dry farms of southern Idaho are wheat, oats, barley, and field peas. Winter wheat is the great commercial crop on the dry farms of the Snake River basin. Three-fourths of the dry-farm cereals produced in Idaho is winter wheat.

In this bulletin a brief description of the climate and soils of southern Idaho is first given. The equipment of the dry farm is then discussed, followed by directions for growing the principal grain crops and recommendations as to the best varieties to grow.

THE SNAKE RIVER BASIN.

The statements in this bulletin apply to the Snake River plains of southern Idaho and the dry-farmed valleys opening into this great basin. This section includes most of the counties of Fremont, Teton, Jefferson, Madison, Bonneville, Bingham, Bannock, Bear Lake, Franklin, Oneida, Power, Cassia, Minidoka, Blaine, Lincoln, Twin Falls, Gooding, Owyhee, Elmore, Ada, Canyon, Boise, Washington, and Adams. (Fig. 1.) Irrigation is largely practiced in some of these counties, but only dry-farm crops and practices will be discussed here.

The elevation varies from 6,500 feet in the upper Snake River basin near the Wyoming line to 2,100 feet in the lower part of the basin, close to the Oregon line.

Elevation and moisture supply are the controlling factors in dry farming in southern Idaho. The growing season varies in length from about 75 days at the higher elevations to about 140 days at the lower levels. The number of crops grown is not as great, however, as might be expected. This is due largely to the lack of sufficient moisture for growing spring crops profitably and to the cold nights, which prevent growing the more tender crops. Dry farming is being practiced as high up in the mountain valleys as the freedom from summer frosts and the length of the growing season permit.

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[1] The Aberdeen Branch Experiment Station was established at Aberdeen, Idaho, in the fall of 1911. The Aberdeen Commercial Club obtained a 15-year lease on 80 acres of land for the State. The club also supplied the funds to erect buildings and fences and to install a water system in the buildings.

The station is maintained by the Idaho Agricultural Experiment Station and the Bureau of Plant Industry in cooperation. The land was cleared and made ready for crops in 1912, and the first crop from the dry farm was obtained in 1913.

CLIMATE.

The general climate of the Snake River plains is arid or semiarid. The climatic conditions vary greatly, however, owing to variations in altitude and the influence of adjacent mountains.

In the upper Snake River country the temperature seldom rises higher than 90° F. in summer or falls lower than 15° or 20° below zero in winter. At the lower elevations near the Oregon line summer temperatures of 100° or higher are often reported, while the winter minimum seldom reaches zero. Throughout this section the daily range of temperature is very great. The nights are usually cool, accounting in a large measure for the poor growth of corn and sorghum in the upper Snake River country.

The average yearly rainfall of the Snake River plains is 10 to 13 inches. At the high elevations it is greater than in the valleys. The distribution of summer rainfall is very irregular. In the mountain valleys the snowfall is much heavier than on the plains. Warm Chinook winds cause rapid melting of the light snowfall on the plains, with the result that if the ground is frozen this moisture escapes as run-off.

Westerly winds prevail over the Snake River plains. In summer and fall the winds are frequently strong in the afternoon. The average daily wind velocity is not more than 7 miles an hour.

At the higher elevations frosts occur at frequent intervals during the growing season. These late spring and summer frosts often cause severe losses. Frost limits the number and variety of crops which can be grown in these particular sections.

SOILS.

The soils of the Snake River plains are of volcanic origin. Most of the soil covering the plains at a distance from the mountains and outside the canyons is fine material redeposited by the wind. It is a yellowish white silt composed mainly of small quartz particles. The most common soil type is a sandy clay loam.

The high bench and mountain-valley soils are largely mountain wash or alluvial. This soil type is also a sandy clay loam, but contains more decayed vegetable matter. The mountain soils also contain more sand and gravel than the plains soils and take up more of the water of heavy rains. The color of the mountain-wash soils is a reddish brown. A view of a portion of the Rockland bench in the Rock River valley, Power County, is shown in figure 2.

In the upper Snake River plains small areas of gravelly soil are found. Where this gravel is 4 or 5 feet below the surface dry farming is fairly profitable. If the gravel is close to the surface dry farming is almost out of the question. Much depends, however, upon the nature of the deposit. If considerable soil is mixed with the coarse sand and gravel, the land may be farmed with profit. Gravelly soil can not hold water as does a clay soil, and care should be taken when selecting a dry farm in a locality where gravel exists.

In some sections of the Salmon River valley and farther west a limestonelike hardpan is found at varying depths below the surface. As in the case of the gravel, if this hardpan is several feet below the surface the land can be dry farmed with profit. If it is close to the surface, however, the land is not well adapted to dry farming.

Humus and nitrogen are lacking more or less in the southern Idaho soils. The dry farmer on the plains is handicapped because of lack of sufficient moisture in the soil to rot any great quantity of vegetable matter. Straw, manure, and legumes should be used to help build up the dry-land soils, but owing to the light rainfall this must be done very slowly.

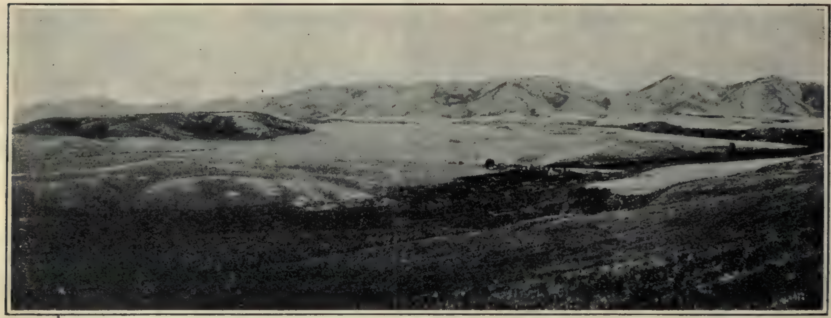

FIG. 2.—A part of the wheat-growing Rockland bench in the Rock River valley of southern Idaho. One range of the Bannock Mountains is shown in the background.

The dry-farm soils, if properly farmed, will yield good returns. If a profitable rotation can be planned, a permanent dry-farm agriculture practically is assured.

DRY-FARMING MACHINERY.

The machinery needed on a dry farm varies with the size of the farm, the kind of soil, the horsepower available, the rapidity with which the work must be done, and, most important of all, the efficiency and economy of operation.

The average dry farm on the Snake River plains is about a half section, or 320 acres. This is the acreage which is granted as a homestead to settlers. Farming on the dry lands of Idaho is so recent that there are as yet few large holdings. There are a few bonanza wheat farms in the upper Snake River basin, on the Rockland bench in Power County, and in the upper Weiser River district. These bonanza farms usually include some of the best land in the locality.

The proportions of clay and sand vary considerably in different soils. A plow which works well on the lower plains may not be adapted to the high bench and mountain-valley lands. The proper kinds of machinery for the various districts are usually obtainable from local implement dealers.

The implements a dry farm should have are a moldboard plow, a double-section disk harrow, a spike-tooth harrow, a drill, a header, and wagons. Desirable additional equipment includes a weeder of some good type, a grain binder on the bench lands, and a corrugated roller. Machinery for clearing land is not included in this list and will not be discussed in this paper.

It is not economy to use small machinery on a dry farm. A sufficient number of horses must be kept to handle large machinery. A 4-horse team is considered a small unit. Five or six good horses can handle a 2-bottom gang plow, a 6-foot double-section disk harrow, a 5-section spike-tooth harrow, and a 16-hole 7-inch drill. The minimum power unit for efficiency on a 320-acre dry farm is five horses. On the other hand, seven horses would be considered the largest efficient unit on such a farm, unless other work can be obtained.

Successful dry farming requires getting on the land at the right time. This requires large machinery, to cover a maximum acreage in a day. Bad weather often delays work. When it is possible again to get on the land, weeds may be growing rapidly, and quick work is needed to keep them under control.

It is not economy to purchase a 10-horse equipment, furnish and feed 10 horses, and then permit them to be idle because of lack of work. Money is made by keeping a medium equipment busy throughout the year. This can be done by a proper arrangement of fall and spring work.

Spring plowing for fallow done at the right time and in the right way yields as much winter wheat as fall plowing. Hence, it is not necessary to maintain enough horsepower to handle both fall sowing and fall plowing for fallow. Divide the work. It pays.

PLOWS.

Good plowing is essential, and plows should be selected with great care. It is better to buy a 2-bottom gang plow and put on a 6-horse hitch than to buy two single-bottom plows and put a 3-horse hitch on each. The wage of a teamster is saved, and a little more work is done in a day by using the 2-bottom plow. Where sufficient horses are available and the work to be done demands and warrants their purchase, 3-bottom plows can be used to advantage. In early spring plowing it is best to add an extra horse and tie a small harrow behind the plow. Thus the teamster plows and harrows at one operation, and the prompt harrowing saves moisture. In fall plowing the harrow should not be used, as it is better to leave the land rough over winter to catch snow and rain and to prevent soil blowing in the spring.

The disk plow has only a limited use on the average dry farm in southern Idaho. It has special value in plowing hard, dry ground in summer, stony land, trashy sagebrush land, or the sticky clay spots found in some sections of southwestern Idaho. Turning under brush, however, is not a good practice, for it leaves the soil loose and rough. Much moisture is lost, and a good seed bed can not be made. The dry farmer can not afford to plow land when it is hard and dry. Land should be plowed when it is in proper condition. This usually can be done in a normal year. When the soil is in good condition to plow, the disk plow requires as much power and a better teamster to do the same quality and quantity of work as a moldboard plow. The moldboard plow is preferable because it leaves a flat furrow bottom, pulverizes the soil to a greater extent, and provides a more uniform seed bed.

THE DISK HARROW.

A 6-foot or 7-foot double-section disk harrow is one of the most important tools on a dry farm. A cutaway front section followed by a full-disk rear section is to be preferred. This is an effective tool on hard stubble ground. It does better work than a double section of full disks or a front section of full disks and a rear section of cutaway disks. This machine requires from five to seven horses. The double-section disk harrow should have a movable or hinge-joint frame rather than a rigid frame. The front and rear sections should work independently, and the set of each of the four units should be controlled independently by its own lever.

THE SPIKE-TOOTH HARROW.

A good spike-tooth harrow is absolutely necessary on a dry farm. A 5-section or 6-section harrow makes an efficient tool on a 320-acre farm. With this implement various kinds of work can be done, if it is provided with levers to change the slant of the teeth. It can then be used in smoothing land and killing weeds or in cultivating the growing crop, if desired.

THE DRILL.

Single-disk drills are used almost exclusively on the Idaho dry lands. This is largely because the seed bed always contains more or less sagebrush and roots, and sometimes straw. The disk cuts through hard ground, straw, and small brush, whereas the hoe drills and shoe drills clog and cause trouble. The double-disk drill can not be made to go deep enough in some of the soils, although this drill may have a place on some of the land longest farmed.

Scudder[1] states that "on a clean well-prepared seed bed, the hoe drill is satisfactory, but the double-disk furrow opener is perhaps even better, as it gives a better distribution of seed." The opinions of dry-land farmers in various sections of the State favor the single-disk drill, for it does good work under nearly all conditions.

Press-wheel attachments are favored in some parts of the State. Where the soil is coarse and loose they doubtless can be used to advantage. The use of this attachment requires a little more horsepower to handle the drill. Opinion is much divided as to the value of press wheels, the opinions varying with the section, which no doubt indicates that different soils require different treatment.

WEEDERS FOR FALLOW.

The spike-tooth and disk harrows are effective weeders, but there are times when they can not and should not be used. The spike-tooth harrow is effective when the weeds are very small. The disk harrow is effective when the weeds are so well rooted that no other tool will kill them. Disking, however, is expensive and often pulverizes the soil more than is desirable. Various weeders, home-made and manufactured, are now in use. Many of them are cheap, effective, easily operated, and will cover a large acreage in a day.

The "slicker," or knife weeder, is a tool 6 to 12 feet in length. One of the simpler forms is made by nailing boards or planks on top of three or four 2-inch by 8-inch sled runners 3 feet long, with a blade bolted under the middle or the rear end of the runners. This blade is made of a 3-inch iron bar half an inch in thickness and sharpened on the front edge. In the bar weeder, a round five-eighths-inch or three-fourths-inch rod is used instead of a blade. A 6-foot running board is nailed across the top in the middle of the machine and extends to the rear. The driver stands on this board and regulates the dip of the knife or bar by shifting his weight forward or backward. The blade is cleaned by lifting the rear end of the machine. The blade of the slicker should be made of the best steel and kept sharp.

ROLLERS AND PACKERS.

A few farmers are now using the corrugated roller to firm the summer fallow after plowing, to firm spring-plowed land which is to be sown to spring grains, and to break crusts and close up large cracks in the fields of winter wheat. These cracks usually appear on the heavier soils, especially after a winter of heavy snowfall, and are often 3 to 4 inches deep. The corrugated roller has been used with good results for these purposes at the Aberdeen Branch Experiment Station. This roller not only closes the cracks, but loosens the surface soil, thus preventing further baking and hardening.

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[1] Scudder, H. D. A report of the experimental and demonstration work on the substation farms at Moro, Burns, Redmond, and Metolius. Pt. I, Tillage and cropping methods. Oreg. Agr. Exp. Sta. Bul. 119, p. 54. 1914.

The subsurface packer has not proved to be of much value on the dry lands of Idaho. Its limited field of usefulness does not warrant the purchase of the machine on the average drv farm.

HARVESTING MACHINERY.

The header is the most important harvesting machine on the dry farm. It is used extensively in all sections of the State. The header consists of a raised grain table, equipped with sickle, moving canvas apron, and revolving reel, as in the binder. Unlike the binder, the header removes only the heads and upper part of the stems. These are elevated directly to a large wagon box and hauled either to a stack or to a separator. A complete equipment for heading grain is shown in figure 3. Figure 4 shows the thrashing of headed grain from the stack, and figure 5 the thrashing of grain hauled directly from the header to the separator.

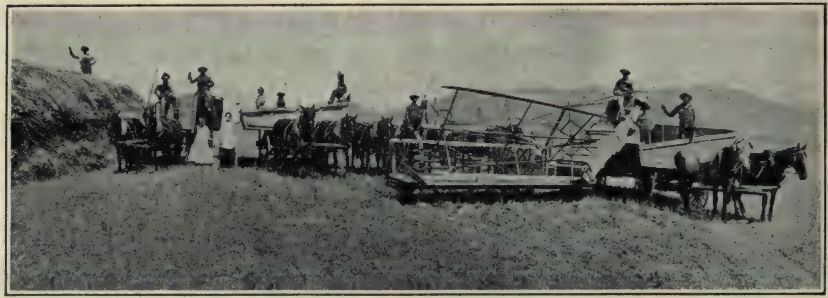

FIG. 3.—Complete outfit for heading grain, consisting of a header and three header wagons, near American Falls, Idaho.

On the mountain bench and valley lands binders are used to a considerable extent. In these sections the straw is much longer than on the plains. Bound grain can be handled better than headed grain. Grain also is bound in these sections because it often is impossible to get a thrashing outfit to the farm. This makes it necessary to haul the bound grain to the separator.

Binders also are used to a considerable extent to cut green wheat for hay. Bound wheat hay can be handled much easier than loose hay. Since it is not raked from the ground it never contains as much dust as loose wheat hay. Not all binders, however, will cut green wheat and tie it.

The combined harvester-thrasher, or combine, is used in nearly all sections of the State. This machine has come to stay. It consists essentially of a long platform and elevating aprons, as in the header and the binder, attached to a portable separator. Thus grain is cut and thrashed at one operation. Great improvement has been made in the combine in recent years.

All combines until recently were large machines. The original large combines required 30 or more horses to pull them. In some sections of the United States even larger combines were developed which required powerful tractors to operate them. The capacity of such combines varies from 30 to 75 or more acres a day, depending upon the width of the cut. Large combined harvesters and thrashers drawn by horses are shown in figure 6, and one drawn by a gas tractor is shown in figure 7. Small combines are now made which can be pulled by six to eight horses. These small machines have from a 6-foot to an 8-foot cut and will harvest about 15 acres per day. One of the smaller combines, which requires only 12 horses to operate it, is shown in figure 8.

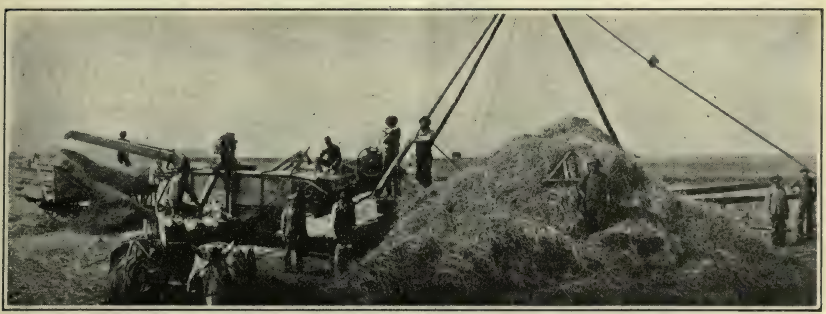

Fig. 4.—Thrashing headed grain from the stack in southern Idaho. The straw is blown into hayracks and hauled for feeding.

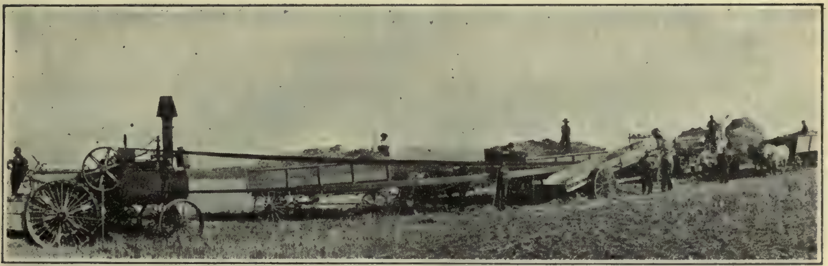

Fig. 5.—Thrashing from a header outfit in southern Idaho, using a straw-burning engine.

The addition of an auxiliary engine to run the cutting and separating machinery makes a combine run much steadier, and better work is done. This also reduces the number of horses needed, as the only power required is that which pulls the machine over the ground.

The combine has been criticised because the cost of sacks increases the cost of harvesting and because weed seeds are distributed over the land if weeds are present in the ripened grain. An Idaho farmer has saved the cost of sacks by erecting an elevator on the farm and hauling the wheat in bulk from the combine to this elevator. The thrashed wheat runs directly from the separator into a receiving bin on top of the combine and thence to the wagons. If a wagon fails to reach the combine in time, this large receiving bin takes care of the surplus until the wagon arrives. Thus the harvesting goes on continuously, as it is not necessary for the combine to stop and wait for wagons.

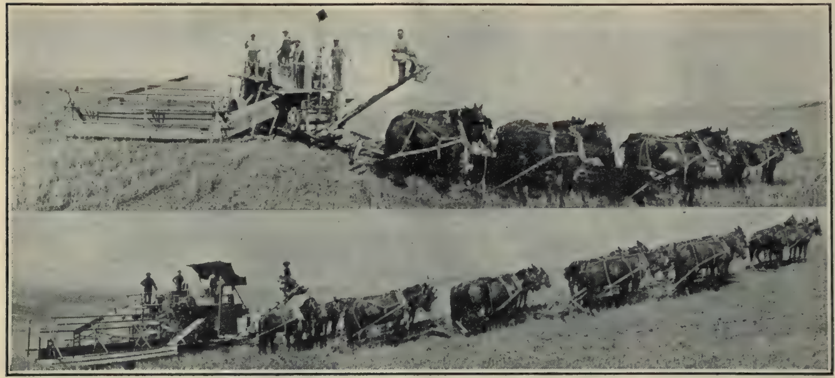

FIG. 6.—Two combined harvesters and thrashers drawn by horses near American Falls, Idaho. The upper combine is equipped with an auxiliary gasoline engine to run the harvesting and thrashing machinery, 14 horses being required to pull the machine. Below is a combine of the same size without an auxiliary engine, requiring 28 horses to draw the machine.

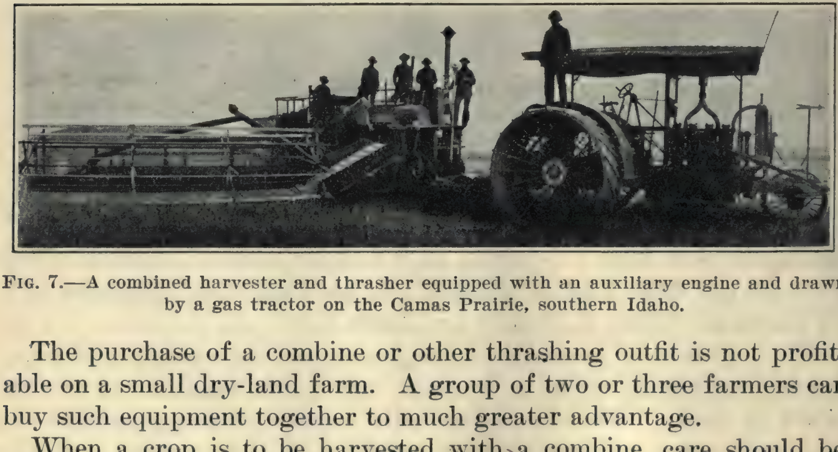

FIG. 7.—A combined harvester and thrasher equipped with an auxiliary engine and drawn by a gas tractor on the Camas Prairie, southern Idaho.

The purchase of a combine or other thrashing outfit is not profitable on a small dry-land farm. A group of two or three farmers can buy such equipment together to much greater advantage.

When a crop is to be harvested with a combine, care should be taken to grow varieties which do not shatter. Wheat must be fully ripe or overripe before good work with a combine can be done.

Turkey wheat is well adapted for combine harvesting, because it holds the seed well when fully ripe.

GOOD SEED.

HOME-GROWN OR IMPORTED SEED.

Wheat growers and seedsmen often claim that wheat "runs out." Some of the best farmers in southern Idaho ship in Turkey wheat from other localities every three or four years because they say their seed is running out. These growers think that yields decrease and the percentage of yellow berry increases each year the crop is grown.

This is not really the case. If properly handled, the quality of the crop can be improved or at least maintained as long as it is grown in a community. The variety becomes adapted to local climatic conditions. If the conditions are severe, only the best and most fit plants survive.

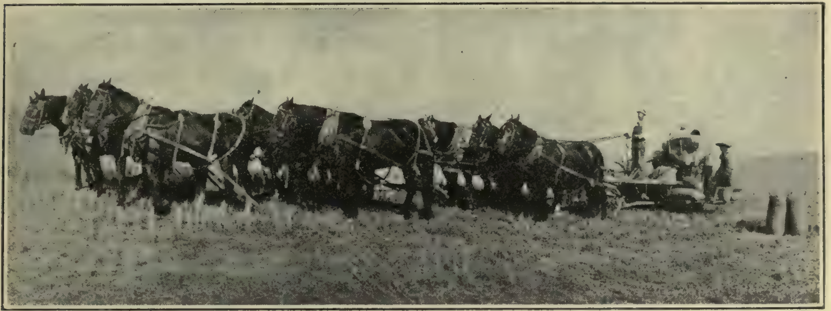

FIG. 8.—A small combined harvester and thrasher requiring 12 horses and two men for its operation.

The results of many experiments prove conclusively that the source of seed has nothing to do with the proportion of yellow berry in the crop in any year. It is proved also that decreased yields need not result from using home-grown seed. Other factors are responsible for the low yields.

GRADING THE SEED.

Grading the seed with a fanning mill will do more to maintain yields than the introduction of new seed. Blow out all the chaff, straw, and shrunken kernels. Sow only plump seed, which contains plenty of food to supply the sprouting plant until the roots are able to obtain food from the soil. Plump grain also is less injured by the smut treatment and always germinates better than shrunken seed. Get a pure, high-yielding variety from your State experiment station or some other reliable source and then take good care of it.

TREATING WHEAT FOR BUNT OR STINKING SMUT.

The first essential in treating wheat for bunt or stinking smut is to fan the grain well, thus blowing out all light material and any smut balls that may be present. If smut balls still are present, put the wheat in a barrel of water. The balls come to the surface and can be skimmed off. The water is then drained out of the barrel, and the seed resacked and made ready for immediate treatment in the smut-destroying solution.

The formaldehyde treatment for stinking smut requires soaking the grain about 10 minutes in a solution of 1 pint of commercial formaldehyde to 45 gallons of water. The seed should then be dumped in a pile, preferably on a canvas, and covered for two hours. This is done to distribute the formaldehyde gas throughout the pile and to prevent the escape of the gas. The seed then should be spread out thinly on a canvas, dried sufficiently to sow in the drill, and put in sacks which have been dipped in the formaldehyde solution. The hopper and tubes of the drill should also be cleansed with the solution, in order to keep the treated seed free from smut. It is useless to treat seed and then sow it in a drill which has smut spores in the hopper or tubes. By using preventive measures a great deal of the loss from smut can be avoided. This treatment is also effective in preventing oat smut. For further information on the smuts of cereals, see Farmers' Bulletin 507, entitled "The Smuts of Wheat, Oats, Barley, and Corn."

SEED-BED PREPARATION.

Seed-bed preparation includes the preparation of the land for winter and spring crops and the maintenance of summer fallow. It includes also the time and depth of plowing as they affect these operations. Cereals require a firm, well-compacted seed bed.

Results in southern Idaho at present indicate that it makes little difference in the moisture content of fallow whether the stubble land is plowed in the fall or in the spring. Plowing in the spring, however, should be done early, to conserve the most moisture in the soil.

Good plowing is not necessarily deep plowing. Deep plowing is advisable at times in order to break up the plow sole. The annual rainfall over most of the Snake River plains is between 10 and 12 inches. Coming as it does in small quantities throughout the year, it requires only a shallow soil reservoir to catch and hold it. The most successful dry farmers in Idaho plow from 5 to 6 inches deep. The better farmers on the alluvial or mountain-wash soils of the high bench lands usually plow a little deeper and claim that it pays them. On the plains, however, plowing 5 to 6 inches deep is ample.

The first breaking of new land usually is done about 4 inches deep, but it should be 6 inches deep, as the sagebrush roots prevent a good job of shallow plowing. The plow is thrown out of the ground whenever a tough root is struck, which causes an uneven seed bed, only partially plowed.

Winter crops usually are sown on land which has been plowed in spring and then summer fallowed. It is difficult to prepare a good seed bed for winter wheat following a winter-wheat crop. The ground is dry and hard, plows up in large lumps, and too much work is required to reduce it to proper condition. In only one year out of four at the Aberdeen substation has it been possible to make a good seed bed after winter wheat was removed in time to sow winter wheat again by the middle of September. Spring plowing and summer fallowing are the rule.

Disking the stubble land either in the autumn or in the spring before it is plowed is profitable. If only one disking can be given, the work should be done in the spring. The land plows easier, because evaporation is checked and moisture is held. The hard surface crust formed during the growing of the crop is broken up, thus preventing rough, lumpy plowed land. The cut straw is mixed with the surface soil and when turned under is well covered. No air space remains below the furrow slice. More plowing can be done in a day with the same horsepower, as the draft is much less. Weeds are killed, and weed seeds are caused to germinate, so that the young weeds can then be destroyed by the plowing which follows.

For spring crops, land plowed late in the fall gives more satisfactory results than spring-plowed land. This is no doubt due to the looseness of the seed bed on spring plowing. To make a compact seed bed, plowed land must have time to settle. The packer, the corrugated roller, or the disk harrow set straight is a good tool to firm the spring-plowed seed bed for spring crops. However, no implement can do in a short time what months of weathering and settling will accomplish in compacting a seed bed. This firming of the spring-plowed land is done to prevent the drying out of the soil, which would delay the germination and growth of the crop.

Land plowed early in the spring for fallow should be firmed soon after plowing. If harrowing is not sufficient, the packing should be done with a corrugated roller or packer. The various weed-killing tillage operations during the summer help to firm the soil, so that by sowing time in the fall a good seed bed is ready. When early fall rains occur, they aid greatly in firming the summer-tilled land.

Soils which blow readily, such as the light sandy loams east of Camas, Idaho, are difficult to handle. Such land is better farmed in strips about 100 feet wide running at right angles to the prevailing winds. Every other strip is cropped, and the strips between are fallowed. Disking and stubbling in the seed is about the best means of getting a crop and preventing blowing on these soils. They should not be plowed until considerable stubble has been worked into the surface, and then only shallow plowing should be done until the straw is well mixed with the surface soil.

Southern Idaho dry farmers should summer fallow, as no crops have yet been found that can be grown profitably in place of the summer fallow between two crops of wheat. Moisture is the important thing in crop production on the dry farms of the Snake River plains. Experience shows that summer fallowing stores sufficient moisture to produce a profitable crop of grain every second year. Under the same climatic conditions, cropping every year is usually not profitable, and in years of extreme drought it is a failure. At the Aberdeen Branch Experiment Station in 1915 the average yield of winter wheat sown on fallow was 13.5 bushels, while on land continuously cropped to cereals the yield was only 3 bushels per acre.

The most successful dry farmers in the Snake River plains area are becoming more and more convinced that alternate cropping and fallow is the most profitable way to grow wheat. Spring plowing, summer tilling, and fall sowing distribute the labor well, keeping men and teams busy most of the year.

Plowing for fallow should be done in early spring. At this time the stubble ground is easily worked. By disking the entire field before plowing is begun much moisture is saved, the land plows easier, and a better fallow is prepared.

The main object in cultivating fallow is to kill weeds. They should be killed when very small, as it requires nearly as much moisture to grow a weed crop as it does to grow a crop of grain. The slicker or some other type of weeder should be used for this purpose. The soil is not so finely pulverized with these tools, the cost of operation is about one-third the cost of disking, and a good clod mulch remains. Frequent cultivation is expensive and also fines the soil too much. A fine dust mulch is sure to blow during the dry season.

CEREAL CROPS.

The most important cereal crop in Idaho is wheat. Oats and barley are grown to only a limited extent on the dry farms.

WHEAT.

Hard and soft winter and soft spring wheats are grown. The hard red winter wheats are the leading ones in the section under discussion.

WINTER WHEAT.

Climatic factors make winter wheat the major crop on the dry farms of the Snake River basin. The greater part of the precipitation falls between September and May. A large part of this moisture is stored in the soil and is available for the early spring growth of winter crops.

The winter-wheat crop takes advantage of the earliest growing period in the spring and is often well along before the spring crop is sown. This advances the ripening period of winter wheat and often enables it to escape the drought which usually catches the spring grains at a critical period of their growth.

In varietal tests at the Aberdeen substation the yields of winter wheat have been almost double the yields of spring varieties. On the high bench lands and in the mountain valleys, where more moisture is available at the heading and filling stages, the difference in comparative yield is much smaller. The crop at these elevations, however, is always later, and often there is danger from early fall frosts. The late spring and early summer frosts often kill the wheat at the flowering period. Pasturing winter wheat in the spring to hold back growth until danger of heavy frosts is past often will prevent serious loss from frost. The higher rainfall and lower evaporation assist in making a good yield in spite of spring pasturing.

VARIETIES.

Homesteaders in Idaho often bring with them the crop varieties which they were growing in other States; consequently there is a great mixture of varieties in many sections. The Snake River basin, however, is gradually overcoming this handicap. The Turkey, a hard red winter wheat, is now the predominating variety in this section. This is especially true in the eastern and southern parts and in the districts around Cambridge and Midvale in the western part. A field of Turkey wheat in shock on the Rexburg bench near Rexburg, Idaho, is shown in figure 9.

The results of a 3-year varietal test at the Aberdeen Branch Experiment Station show that the Crimean group of hard red winter wheats is the best. This is true also in nearly all parts of the Snake River plains area. Varieties of this group, which includes the Turkey, Kharkof, Crimean, and Beloglina, have regularly outyielded all other winter wheats. These Crimean wheats are gaining rapidly in acreage in all the dry-land sections of the State. They are recommended as the best dry-farm cash crop. The Turkey is proving the best variety, even up to elevations of 6,500 feet in the mountain sections.

Frost seems to be the greatest obstacle at the higher elevations. In these localities varieties are chosen which yield either a good crop of grain or a heavy tonnage of hay. The Turkey and related varieties are not so valuable for hay, owing to the beards and the lighter vegetative growth. The Gold Coin, or some beardless spring variety, is grown because it makes a good hay crop if frosted.

The Gold Coin, or Fortyfold, is still being grown in considerable quantity around Ashton and in the American Falls district. This is a beardless variety with brown chaff and soft white kernels, used largely for hay. Usually it is badly mixed with other varieties.

The minor varieties grown in these districts are mostly from the Columbia Basin of Washington. Washington Hybrid Nos. 123 and 143, winter wheats, are now being grown to some extent for hay purposes in the Cambridge and Midvale districts. They make a heavy growth and when left to ripen do not shatter as much as the Gold Coin. These wheats, however, are not highly valued by the millers and may not be profitable for grain production on the Snake River plains.

FIG. 9.—A field of wheat in shock on the Rexburg bench, south of Rexburg, Idaho.

TIME OF SOWING.

Winter wheat should be sown when enough moisture is available in the soil to bring up the crop. It is not advisable to sow in dry ground. The time of sowing winter wheat varies with the elevation. At the higher altitudes in the upper Snake River basin it should be sown during August. At about 4,000 feet elevation sowing should be done from August 25 to September 25, and at lower elevations from September 15 to October 15.

Seeding after October 1 above 4,000 feet elevation is not profitable, owing chiefly to slow germination, slow growth, and lack of sufficient vigor to withstand winterkilling. On the other hand, seeding too early, especially at the higher elevations, allows the grain to make too much growth in the fall, and it may come to the flowering stage in time to be caught by the late spring frosts. The bottom lands at these higher elevations are most subject to frost damage. Late sowing at the high elevations is to be preferred to too early sowing, as snow protects the crop from winterkilling.

RATE OF SEEDING.

The rate of sowing winter wheat varies from 3 to 5 pecks per acre. The 3-peck rate is best in a dry season, while heavier seeding is best in a wet season. Winter wheat is now sown at the Aberdeen substation at the rate of 3½ pecks per acre with satisfactory results. The rate should be decreased somewhat if the sowing is early, and increased if it is late. An increase of half a peck to a peck to the acre should be made if seed swollen from smut treatment is used.

DEPTH TO SOW.

The proper depth to sow wheat varies with the moisture available in the soil. In a firm, moist seed bed the depth should be about 2 inches. On the looser soils where the moisture is deeper, a depth of 3 or 4 inches often is necessary to get seed down to moist soil. It is not advisable to sow deeper than 4 inches. If moisture can not be reached at that depth the seed should be sown shallow if it is necessary to sow before the rain comes.

CULTIVATION OF THE GROWING CROP.

The harrowing of winter wheat in the spring is a local problem. It is not recommended for most of the dry lands of southern Idaho. On the Rockland and Rexburg benches and in the Cambridge district the practice of harrowing winter wheat in the spring is followed to some extent. However, in these sections neighbors often disagree as to the value of such tillage.

Results at the Aberdeen Branch Experiment Station indicate that harrowing winter wheat in the spring is not profitable. The same results were obtained in the Juab Valley of Utah and at the Moro, Oreg., substation. The small increase in yield did not make up for the cost of the labor. If the wheat is to be harrowed the work should not be done until the plants cover the ground well in the spring. Early harrowing causes serious losses in stand. It is probable that the spring-tooth weeder or some similar tool might be used to advantage, as the wheat would be injured less than with the harrow. Harrowing winter wheat in the spring is not recommended for the greater portion of the Snake River plains.

The corrugated roller is being used quite extensively in the spring on winter-wheat fields in the Rockland district to break the crust and close large cracks. The heavier soils in this section bake and crack after a winter of heavy snowfall, and the corrugated roller does better work in correcting this condition than any other tool yet used.

SPRING WHEAT.

Spring wheats are not profitable crops to grow on the dry lands of most of the Snake River plains, because of a lack of moisture at the time of heading and filling. They can be grown profitably on the high bench lands and in the mountain valleys. Spring wheats are grown to some extent on the Rexburg (Madison County) and Rockland (Power County) benches and in the Montpelier district (Bear Lake County). The soils in these sections are alluvial or mountain wash, and the precipitation is greater than on the plains. However, in all these sections the Turkey will outyield the spring varieties unless injured by frost. At these high elevations snow often remains on the land until late in the spring, making impossible the early preparation of the soil. This delays spring seeding, and the crop is often frosted before ripening. Winter wheats can be sown early in the fall under favorable conditions, and usually make good growth in the spring before spring grain can be sown.

One objection to red wheats on the Rockland bench has been the yellow berry, which is often produced in certain seasons. The market often docks the grower for this wheat. In the last two years white wheat has sold higher than red wheat because of the demand for soft white-wheat flour. This has stimulated the production of white spring wheats in this section.

Spring wheat can be used as a catch crop when winter wheat winterkills or when lack of time prevents sowing enough winter wheat. While good yields of spring wheat sometimes are obtained, it is the average yield in a period of years which counts in selecting the most profitable crop.

VARIETIES.

The Pacific Bluestem is largely grown in nearly all sections where a spring variety is sown. The Sonora is grown in smaller quantity in some localities. On the Rexburg bench the Colorado Special, probably a selection of Defiance wheat, is now the principal variety. It is a new wheat in the State, having been obtained about three years ago. The Little Club, Big Club, and the Pacific Bluestem are grown in the Cambridge-Midvale districts. The Early Baart is being introduced in this section and will probably supplant the other varieties for grain. At the Aberdeen substation and at the Eastern Oregon Dry-Farming Substation at Moro, the Early Baart is one of the highest yielding varieties grown. It is an early, bearded, white wheat.

Spring wheats are not recommended over winter wheats, but it often becomes necessary to grow a small acreage of the former. The Early Baart, Pacific Bluestem, and Colorado Special are leading varieties and are producing the best yields of all spring varieties. The Sonora and Ninety-Day wheats are not recommended. Both are rated low in milling value, and the latter is a badly mixed hybrid.

SEEDING SPRING WHEAT.

Spring wheat should be sown as soon as the frost is out of the ground and the soil warms up a little. The time of sowing will vary considerably with the elevation. At the lower elevations seeding often can be done before April 1. At the middle elevations the usual date is about April 10. High elevations retard the seeding date, as the snow does not melt until late and the excess moisture in the soil prevents early tillage.

Spring wheat should be sown at a rate of 4 to 5 pecks per acre at the low elevations and 5 to 6 pecks at the higher elevations. It is very easy to sow too thick in the lower plains. Spring wheat matures at a time when the weather is very dry and there is little moisture in the soil. If the stand of wheat is too thick there is too much crop for the water available and the yield and quality of grain suffer as a result.

OATS.

On the Snake River plains oats are grown for feed, but not as a commercial crop. In the mountain valleys, however, oats are grown commercially with considerable success. At these elevations moisture is available until the ripening period. Oats, however, are not a very profitable crop on the dry lands of the Snake River plains. Whether at high or low elevations, it is essential that an early variety be sown. This is especially necessary at the high elevations, in order that the crop may mature without danger from August frosts. At the high elevations frost and the length of the growing season are the controlling factors of crop production, as sufficient moisture is usually available.

VARIETIES.

Winter oats are not winter hardy in southern Idaho. Only the early spring varieties should be grown on the dry lands. The Sixty-Day and Kherson are the two highest yielding varieties at the Aberdeen substation and also at the Eastern Oregon Dry-Farming Substation at Moro. At Aberdeen the average yield of the Sixty-Day oats for three years is 38.6 bushels and of the Kherson 32.3 bushels. These are both early yellow oats, originally from southern Russia.

SEEDING SPRING OATS.

The rate of seeding for oats on the dry lands varies from 5 to 7 pecks per acre. On the lower plains the 5-peck rate should be used, because there is comparatively little available moisture. At the higher elevations the heavier rate is used. The rate also varies with the variety. The Sixty-Day and Kherson varieties are small kerneled and do not require heavy sowings to insure a good stand.

BARLEY.

Barley is grown largely for seed in southern Idaho. At the present time it is the crop next in importance to winter wheat on the dry lands. Both winter and spring barleys have been grown at the Aberdeen substation, but only spring barley is grown commonly in southern Idaho.

WINTER BARLEY.

Winter barley is winter hardy only at the lower elevations. It is not recommended for the dry lands in Idaho above an elevation of 3,500 feet. At lower elevations on the Snake River plains, winter barley lives through the winter, and where good stands are assured it is to be preferred to spring barley on dry land. At the Aberdeen Branch Experiment Station, at an elevation of 4,400 feet, a fair crop of winter barley has been produced once in three years. The Tennessee Winter barley has proved to be the best variety.

The rate of seeding winter barley should be 5 to 6 pecks per acre. The time and depth at which to sow and the methods of soil preparation and seeding are the same as for winter wheat.

SPRING BARLEY.

An early variety of spring barley should be grown in order that, like winter wheat, the crop may mature before the summer drought. The two leading varieties at Aberdeen are the Mariout, an early 6-rowed bearded hulled barley, and the White Smyrna, an early 2-rowed bearded hulled variety. The Mariout has averaged 30.9 bushels and the White Smyrna 28.3 bushels in a 3-year period. These varieties are also among the leaders at the Moro, Oreg., substation.

Spring barley is sown at the rate of 5 to 7 pecks per acre, 6 pecks being the normal rate of seeding. If naked or hull-less barley is used, the rate is decreased to 5 pecks. The time and depth of sowing are the same as for spring wheat.

MINOR GRAIN CROPS.

Emmer, spelt, rye, and flax have all been tested at the Aberdeen substation. Of these crops only rye is at all commonly grown in southern Idaho.

EMMER AND SPELT.

Winter emmer and spelt are grown in southern Idaho only in an experimental way. These crops are not as hardy as winter wheat and are not recommended for commercial production. Spring emmer and spelt have not been tested at the Aberdeen substation.

RYE.

Rye is grown to a very limited extent in southern Idaho. Winter rye makes good early pasturage and also makes good hay if cut early. The Ivanof variety is one of the better types. The rate of seeding should be 2 to 2½ pecks per acre. The time and depth of sowing are the same as for winter wheat.

FLAX.

Flax has been grown in a very limited way in a few dry-land sections of the State. Several varieties have been grown at the Aberdeen substation, but the results to date do not justify recommending the crop for commercial production. If tried on a small scale, the seed should be sown at the rate of 15 to 18 pounds per acre.

CANARIES

THEIR CARE AND MANAGEMENT

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FARMERS' BULLETIN 770

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Biological Survey
E. W. NELSON, Chief

Washington, D. C. **December, 1916**

THIS BULLETIN, intended to meet the requests continually received for information on the care of canaries in sickness and health, is compiled from numerous sources, and includes also some personal experiences and observations of the author. In it the history of the domestication of the canary is touched upon, and there is a brief account, with illustrations, of the common and fancy varieties, which are distinguished by shape and color. The chief usefulness of the bulletin is in its discussion of practical problems. There is a section on the style of cages and their sanitation. Detailed information is given concerning bathing, molt, and food, including the feeding of special foods for deepening the color of the birds. One chapter shows the possibility of breeding canaries in captivity and is designed as an aid to this. The concluding pages deal with the health of the birds. Methods of ridding them of vermin are set forth, as well as instructions for caring for fractured legs and wings, and for the treatment of respiratory and intestinal diseases and of such ailments as loss of feathers. The bulletin is intended for all who are interested in canaries.

CANARIES: THEIR CARE AND MANAGEMENT.

CONTENTS.

	Page.		Page.
Introduction	3	Breeding	14
History	4	Sex and age	16
Varieties	5	Vermin	17
Cages	7	Care of feet and bill	18
Care of cages	9	Broken limbs	19
Food	10	Loss of feathers about head	19
Bathing	11	Diseases	19
Molt	11	Respiratory troubles	19
Color feeding	12	Intestinal complaints	20

INTRODUCTION.

Among the birds kept for household pets none is so common or so well known as the canary. So simple are its requirements in the way of food and care that it needs little attention, and because of its pleasing songs and interesting habits it is a universal favorite. Readily adaptable to cage life, canaries display little of the fear shown by wild birds in captivity, and the ease with which they may be induced to nest and rear young adds to their popularity.

Canaries have been domesticated for several hundred years and, though more common in western Europe and the United States than elsewhere, have been carried over practically the entire civilized world. In England and Germany there are hundreds of canary breeders and many avicultural societies. Several periodicals dealing solely with cage birds are published there, and in the larger cities bird exhibitions are held annually. In the United States there are comparatively few fanciers as yet, so that, though numbers of canaries are reared here, a large part of the stock is secured from abroad. More than three and one-quarter millions of canaries have been brought into the United States during the last 10 years, an average of more than 300,000 birds each year. Most of these have come from Germany, but some are imported from England.

Canaries seem to thrive in any climate where not exposed to too severe weather conditions, and in spite of the long period they have been protected and held in captivity they are capable of enduring a surprising degree of cold when hardened to it. In England it is not unusual to find them in outdoor aviaries throughout the year. They seem able to establish themselves again in a wild state under favorable conditions. In 1909, a brood of domestic canaries was released on Midway Island, a small sandy islet in the Hawaiian group. By 1914 they had increased until it was estimated that they numbered about 1,000.

HISTORY.

The actual origin of the canary as a cage bird is as obscure as is the early history of other domesticated animals. It seems probable that captive canaries were first secured from the Canary Islands, a group with which they have long been popularly associated. There are in the Old World, however, two closely allied forms from which the domesticated canary may have come. One of these, the bird now recognized as the "wild canary" (see illustration on title-page), is found in the Canary Islands (with the exception of the islands of Fuerteventura and Lanzarote), Madeira, and the Azores. The other form, the serin finch,[1] ranges through southern Europe and northern Africa, extending eastward into Palestine and Asia Minor. In a wild state these two forms are very similar in color and to a novice are hardly distinguishable.

If, as is supposed, the original supply of canaries came from the Canary Islands, it may be considered doubtful that the stock thus secured has furnished the ancestors of all our canaries. The slight differences in color between the serin finch and the canary would probably have passed unnoticed by early ornithologists and bird lovers. With bird catching a widespread practice in middle and southern Europe, the serin would often be made captive and be accepted without question as a canary. In this way serins and wild canaries may have been interbred until all distinguishable differences were lost.

The original canary, whether serin or true wild canary, in its native haunt was much different in color from its modern pure-bred descendant. The back of the wild bird is, in general, gray tinged with olive-green, especially on the rump, with dark shaft streaks on the feathers. Underneath it is yellowish, streaked on sides and flanks with dusky. Wild canaries from the Canary Islands, the Azores, and Madeira differ from the continental serins in being slightly grayer with less of yellowish green in the plumage above. In addition, the rump is duller yellow and the bill is distinctly larger. All of the wild birds have the feet and legs (tarsi) horn brown, the upper half of the bill dark brown or horn color, and the lower half paler.

Both of the wild varieties inhabit vineyards, thickets, and more open country where bordered by trees. At times during fall and winter great flocks are found together. The birds feed upon various seeds and occasionally eat figs or other small fruits in season. In a wild state they nest early in spring and again later, rearing two broods. The nest, made of plant stems and grasses and lined with hair and plant downs, is placed in bushes or low trees. The eggs are clear green in color, spotted and clouded with deep wine red and reddish brown. From three to five eggs are deposited.

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[1] The scientific name of the serin is *Serinus serinus serinus*. The wild canary is known as *Serinus s. canarius*. Both were first described by Linnæus.

VARIETIES.

Variation among domesticated canaries began early, as Hernandez, in 1587, speaks of the canary as wholly yellow in color save for the tips of the wings. The various forms have had their origin in distinct geographic areas, and though some are almost extinct at present, all at one time or another have had a devoted following of fanciers. At present at least 14 distinct strains, with a large number of varieties, are known.

The common canary is reared primarily for its song, and from it probably came the roller, or song canary, a great favorite in Germany and, more recently, in England. In rearing song canaries attempt is made to produce males with clear, soft, pleasing songs with long rolls or trills, and no attention whatever is paid to other characters. These birds, therefore, are usually nondescript as regards color and appearance, but care is taken in mating to secure males that are good singers and females from good stock. The young birds when fledged are put in rooms with birds noted for their soft song, and here, through imitation, they develop their own vocal powers. Careful watch is kept over them, and any bird developing harsh notes is removed at once to prevent his corrupting the purity of tone in the song of his brothers. A mechanical instrument known as a bird organ, that produces liquid trills, is frequently utilized in training, usually when the adult birds are silent during molt. Ordinarily the room where these birds are kept is darkened, and frequently the cages containing the young birds are screened with cloth to lessen a tendency to objectionable loudness of song. In six months or less, their education completed, these songsters may be sold or in their turn utilized in training others still younger. It is common to teach these birds some simple strain or air, through its constant repetition by whistling or by means of an instrument. Well-trained birds bring high prices, and a fair number of these find their way each year into this country.

In the great class of exhibition birds perhaps none is more striking than the Belgian canary (fig 1). Formerly known as the "king of the fancy," it was reared extensively in Belgium, but of late years its popularity has been on the decline. In 1911 it was said that few pure-bred Belgians were to be found, and under present war conditions it may never recover its own. The typical Belgian canary is a large bird with a small head, long, slender neck, large shoulders, and a long, tapering body. It is primarily a bird of "position." When examined it hops up on a perch and throwing its shoulders up brings the head down well below their level. The back and tail form a perpendicular line and the feet are held close together.

Another bird of position is the Scotch fancy canary (fig. 2). This variety resembles the Belgian, but when in position throws the tail in under the perch until its outline in profile is almost a semicircle.

Another well-marked variety is the cinnamon canary, one of the earliest forms to appear, but one whose origin is wholly unknown. Its true color is a dun or dull brown that has been likened to cinnamon. In exhibition birds the color is usually intensified by color feeding (see p. 12). In addition to the body color the cinnamon canary is peculiar in possessing red or pink eyes, a character that denotes cinnamon blood even in a yellow or buff bird. The cinnamon inheritance is transmitted only by the male; young reared from a cinnamon mother and a male of any other form lacking cinnamon blood never show signs of their cinnamon parentage.

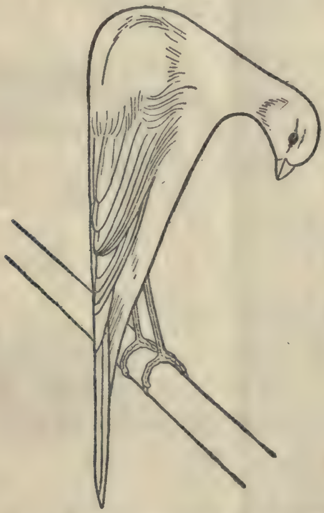

FIG. 1.—Belgian fancy canary.

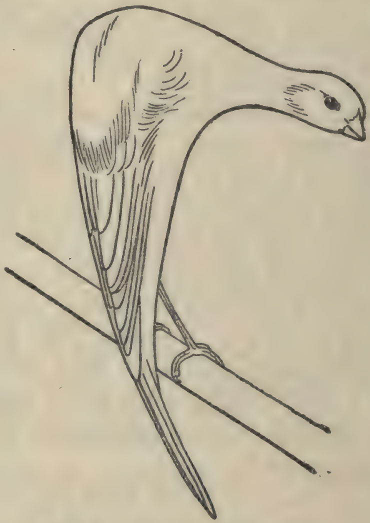

FIG. 2.—Scotch fancy canary.

Among the old-established varieties that now are in decadence none is more striking than the lizard canary (fig. 3). Lizard canaries are known as gold or silver according as the body color is yellow or silvery gray. The wings and tail are black and the back is spangled with numerous somewhat triangular black spots. The crown in pure-bred birds is unspotted and light in color.

The crested canary is another unusual form, with a long crest extending down around the head below the level of the eyes (fig. 4). The frill or Dutch frill canary is a large bird with long curling feathers. The Lancashire is the largest of known varieties of the canary, standing head and shoulders above all others. These "giant" canaries may be crested or smooth headed. Other forms that may be mentioned are the border fancy, a small bird, and the Norwich, or Norwich plain head, from which come many of the common canaries.

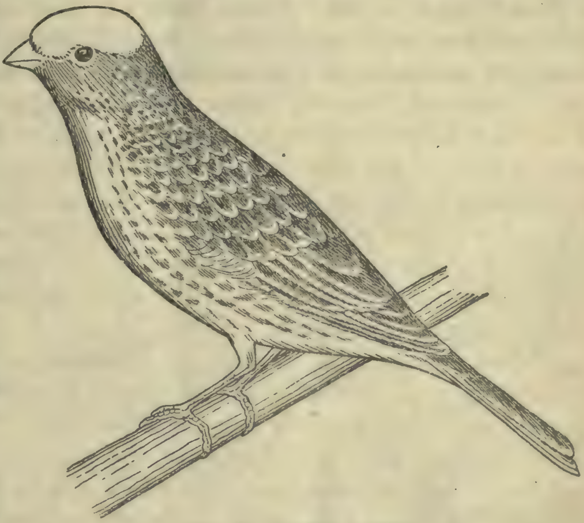
FIG. 3.—Lizard canary.

It must not be supposed that the number of varieties of canaries enumerated covers the entire field. For each of the main forms there are almost endless groups or divisions that have been developed on color peculiarities. To obtain pure-bred birds requires constant care and supervision, and with any slackness of method a host of mongrels appear. Interbreeding between the various forms, differing so widely in color, results in reversion to the original type, which was a spotted or striped greenish bird, certain proof of the common origin of all.

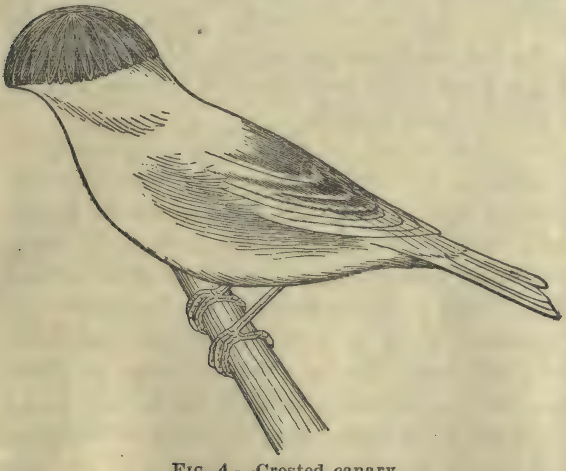
FIG. 4.—Crested canary.

CAGES.

When choosing cages in which to keep canaries, the primary consideration should be the comfort of the birds, and this should not be sacrificed to any desire for ornate appearance. There are several types on the market, any of which may serve. So far as shape is concerned, the square cage is best, as it affords more room for exercise than one with rounded corners.

For a single bird, the cage should be at least 9½ inches long, 6½ inches wide, and 9 inches high. A larger size is much better. The ordinary cages secured from dealers in this country are made of wire and are open on all sides. Each is fitted with receptacles for food and water, usually at opposite ends. A fine-mesh wire screen may be secured from the dealer and fastened around the lower half of the cage to prevent the scattering of seeds and seed hulls. A common substitute for this is a simple muslin bag, held in place by a drawstring fastening tightly about the middle of the cage. In a cage of ordinary size three perches are sufficient. One should be placed at either end at a distance that will allow easy access to the food and water receptacles, and the third elevated above the middle of the cage at its center. A bird confined in small quarters is dependent for exercise on hopping about from perch to perch, and this arrangement will give the maximum freedom of movement. In larger cages four perches may be advisable. These should not be placed so that they interfere with the free movement of the bird, and for reasons of cleanliness one perch should not be directly above another. In small wire cages, if the swing perch usually found suspended in the center is removed, the bird will have more room, and in hopping back and forth will not be continually striking head or wings. In larger cages this perch may remain. Perches should be large enough for the toes of the bird to grasp them readily and encircle them for three-fourths of their circumference. If they are too small they cramp the foot and cause trouble. They should be elliptical in shape, with the flattened portion above. If perches furnished with the cage do not meet these requirements, others may be made from soft wood without much trouble.

Cages in which canaries are to breed must be large and roomy in comparison with those intended for single occupants. An English authority gives the standard size for breeding cages as 22 inches long, 12 inches wide, and 16 inches high. Several types of open breeding cages made of wire may be obtained, or a box with a wire front may be made. The latter is recommended by breeders who rear large numbers of canaries, as it is both convenient and inexpensive and protects the birds from drafts. Where large numbers of canaries are kept these box cages are placed in racks one above another or arranged on a series of shelves along the wall of the bird room. They are provided with a sand tray three-fourths of an inch deep, that slides in and out from the front and facilitates cleaning. Perches may be adjusted in the following manner: One end is notched and the other has a brad driven in it filed to a sharp point. The sharpened brad is pressed against the back of the cage and a wire on the front slipped into the notch. If made the right length the pressure of the wire will hold the perch in position.

For shipping birds the small wicker cages in which canaries come to dealers are best. These are fitted with deep, narrow-necked food and water receptacles that do not readily spill, so that there is a minimum of waste during the journey. A small packet or sack of seeds should be tied to the outside of the cage in order that the bird's supply may be replenished en route.

CARE OF CAGES.

Though canaries when acclimated can endure a great degree of cold without discomfort, they are very susceptible to sudden changes in temperature, and cold drafts soon prove fatal. This should be borne in mind in choosing a place for the cage. A place along the wall at some distance from a window is better for the bird, yet cages are usually suspended before windows. This may be permitted if the window is kept closed and the joints are tight. It may be necessary to line the edges of the window frame and the junction of the upper and lower halves of the window with weather stripping to prevent drafts. The room must remain at a fairly even temperature day and night. For this reason it is best to avoid keeping birds in small kitchens, as the fluctuations in heat are perhaps more marked there than in any other part of the house. Exposure to damp air is also likely to be fatal, another reason for avoiding the steam-laden air of small kitchens. Direct exposure to a strong draft of cold air must always be avoided. A cage may be placed on a small shelf along the wall or suspended from a bracket attached to the wall or window casing. Brackets are inexpensive and are convenient for use when it is impracticable to fasten hooks in the ceiling.

Wherever placed, the cage must be kept scrupulously clean if the canary is to remain in good health and free from vermin. Seed supplies must be replenished and water renewed each day. The receptacles for these necessities should be cleaned and washed carefully at short intervals. Cages that have removable bases should have the tray in the bottom covered with several thicknesses of paper. A better plan is to use the heavy coarse-grade sandpaper, known as gravel paper, that may be secured from dealers in cage-bird supplies. This should be renewed whenever the cage is cleaned, and in addition the pan should be washed in hot water from time to time. Lime on the perches may be removed by means of a scraper made of a bit of tin fastened to a wire or tacked at right angles to a stick small enough to pass easily between the wires of the cage. Cages with bottom attached should be provided with a sand tray that slides in and out through a slot in the front. This serves to catch droppings, seed hulls, and other waste, and it may be easily pulled out, cleaned, and refilled with fresh sand.

FOOD.

The food requirements of canaries are very simple. The prime requisite is a supply of canary seed to which is added a small quantity of rape seed and a little hemp. Persons having only a few birds usually buy this seed ready mixed from dealers. The seed should be clean, well matured, and not old. If canaries do not seem to thrive it is well to examine the seed supply and crack open a few of the seeds to make certain that empty husks alone are not being fed. Too much hemp seed should be avoided, as it is very fattening.

In addition to this staple diet, lettuce, chickweed, or a bit of apple should be placed between the wires of the cage frequently. Bread that has been moistened in scalded milk, given cold, is also beneficial at times. If supplies of moist food are not kept strictly fresh and clean, bacterial diseases may result. In feeding moist foods special dishes with holders that slip in through the wires of the cage are recommended. These are sometimes known as food holders or slides. Soft foods must not be made too wet. In the case of bread, enough liquid to soften the food, but not to run or to render it a paste, is sufficient. Perhaps once a week egg food may be given. This is prepared by mincing an entire hard-boiled egg and adding to it an equal quantity of bread or unsalted cracker crumbs.

Care should be taken to use this egg food only when fresh. Cuttle bone should always be available to the canary, and at times it is well to give prepared foods that may be secured from dealers.

During the breeding season egg food must be given daily as soon as the birds are paired. It may be discontinued or given at intervals of three or four days when the female is incubating. The yolk of hard-boiled egg only may be given for the first day after the young hatch. Bread crumbs are added to this gradually, until on the third day egg food as ordinarily prepared is supplied. The usual seed supply should always be present, no matter what other food is given. Attempt should be made to regulate the supply of egg food or other soft food so that all is eaten without waste. The actual quantity will vary with individual birds. When the young are four or five days old green food may be fed, but egg food must be given until they are fully grown and able to crack canary seed for themselves. Meal worms occasionally are good for birds that are not thriving. A craving for animal food may be satisfied by bits of raw steak. It is not well to continue feeding raw meat, as it will cause a foul odor about the cage. For delicate birds, rape seed soaked in water over night and carefully drained until dry is beneficial. When the old birds are caring for well-grown young, feeding cracked hemp seed will lighten their labor. Maw seed (poppy seed) is favored by English canary fanciers as a stimulant, but its use must be guarded.

It is poisonous to most animals, including man, but seems to have no effect upon birds.

BATHING.

Under normal conditions most birds probably bathe daily, and canaries in captivity should be allowed the same opportunity. In open wire cages in common use for singing birds the base is removed and the cage placed over a small dish containing water. In open-front cages in which the bottom is not detachable small bath cages which fasten at the open door are used. These are only a few inches wide but serve to hold a dish for water. Many birds are notional in bathing and at times ignore the offered bath. Usually the small acts of cleaning the cage and renewing the seed and water will excite in them a desire for bathing, and often when a bath is not provided the bird will do its best to perform its ablutions in the small supply of water in the drinking cup. When individual birds obstinately refuse to enter the water gentle spraying will usually induce them to bathe.

Birds brought into strange quarters usually refuse to bathe for the first few days. When water is offered they either ignore it or sitting on a perch go through the motions of bathing and drying, fluttering wings and tail with a great whirring of feathers. The bath should be offered whenever the cage is cleaned, and if left alone the birds will act normally after a few days.

Small china dishes that are not too deep make good bathing pans. When a bird becomes accustomed to one dish it will usually refuse to bathe in another of different shape or color. In winter the water should be warmed until tepid. Even in warm weather too cold water is not advisable. If the room, ordinarily warm, becomes cold temporarily, birds should not be allowed to bathe. With the plumage wet and bedraggled there is increased susceptibility to cold drafts. During molt the bath should be given not more than twice each week. If the bird is molting on color food, one bath each week is sufficient. When breeding, the female canary should not be allowed to bathe from the time the eggs hatch until the young are three or four days old.

MOLT.

Canaries renew their covering of feathers once each year. In adults this molt occurs late in summer, and the first sign of it is the presence of a wing or tail feather on the bottom of the cage. These feathers are shed in pairs, one from either wing or from either side of the tail, dropped at approximately the same time. Never in ordinary circumstances does the canary have the wing and tail entirely devoid of large feathers. This provision is of no particular significance in a cage bird, but enables wild birds to maintain their powers of flight. The bodily covering, too, is renewed piecemeal, so that except about the head there is normally no extensive area wholly devoid of feathers at any time. Some birds drop a few of the body feathers all through the year.

Old birds weak in physical vigor often fail to renew their entire feather covering, and ordinarily there is no remedy for it. A supply of nutritious, easily assimilated food and careful protection during the next molt may result in improvement. Usually this incomplete molt is a sign of extreme age or breakdown, and the bird does not live long.

With breeding birds the molt usually comes immediately after the breeding season. It may begin as early as the latter part of July. Normally it comes during August, and on the average should be at its height in September. Young birds molt the juvenal body plumage after leaving the nest, but retain the first growth of wing and tail feathers for a year. In healthy birds the entire molt requires about two months.

Birds usually need no special care during molt. Though they are in an abnormal bodily state at this time, healthy individuals will come through the period in good condition. Canaries are somewhat dull and stupid when molting and should be disturbed as little as possible. Bathing may be permitted once or twice each week, but if birds do not wish to bathe they should not be sprayed with water, as this may cause fainting. The molt follows its normal course best in rather damp weather. A great change in temperature or a sudden chill may check its progress and occasionally cause serious trouble. If a bird shows signs of distress, it should be placed at once in a warm, protected place. Twenty drops of brandy, five of sweet spirits of niter, and a few shreds of saffron added to the drinking water are beneficial. It is well to add egg food or moistened bread to the ordinary fare once or twice each week during molt. For ailing birds a very slight quantity of sulphur may be added to the egg food, or a weak saffron tea given instead of pure drinking water. A few linseeds in the seed supply give a gloss and sheen to the new feathers not otherwise obtainable.

COLOR FEEDING.

That the color of canaries may be deepened or intensified by certain color foods given during the molt is well known and has attracted much interest. Turmeric, marigold flowers, saffron, cochineal, annatto, port wine, mustard seed, and other agents rich in natural color are often used for this purpose, but it is doubtful whether they exert any real influence. So far as known all successful color foods have red pepper as a base. For a long time methods of preparing and feeding them were kept secret, but now they are outlined in many manuals on canary keeping.

A standard color food may be prepared as follows: To the ordinary egg food (one hard-boiled egg chopped fine with an equal bulk of bread crumbs or unsalted cracker crumbs) add a teaspoonful of ground sweet red pepper. Mix until the food shows an even reddish tint throughout. Each bird to be experimented upon should receive one small teaspoonful daily. The quantity of pepper is increased gradually, until two heaping teaspoonfuls are used. Addition of a little brown sugar and a few drops of pure olive oil is beneficial, and a small quantity of hot red pepper gives a better flavor. The food should be prepared fresh each day. In mixing, allowance must be made for variation in the size of eggs used. In color feeding some canary breeders increase the proportion of sweet red pepper until four teaspoonfuls are added to the usual quantity of egg food. Half a teaspoonful of this concentrated food is allowed each bird. This method may be used during a short, quick molt.

In selecting canaries for experiments in color feeding preference should be given to strong, vigorous, male birds. During digestion and assimilation this food puts more or less of a strain upon the system, and birds that are old or constitutionally weak may not thrive, or may even succumb under the treatment. Color food may be given young canaries at the age of 7 or 8 weeks to produce a deep color at their first molt. Birds with color that is naturally full and rich should be selected. Those having greenish markings or those descended from a male parent well marked with green are preferable. Pale birds seldom color well.

Color feeding to be successful must be started as soon as the birds are ready to molt, and feeding must be continued until no more pin feathers can be found anywhere on the body when the feathers are carefully blown aside. The usual supply of seed must be kept in the cage, for canaries can not subsist on the color food alone. Should a bird refuse the color food, the seed supply may be removed for a short time morning and evening and the color food substituted. Usually in a day or two the stimulating food will be eaten eagerly. Linseeds should be given (as during the regular molt) to impart a gloss to the new feathers. The birds chosen for color feeding should be kept in a dim light away from the windows and with the cages shaded. Open-front cages are easily provided with a screen of paper or cloth, but care must be taken to leave space for ventilation.

The color food actually supplies an enriched color element to the blood that otherwise is lacking. Until the artificial color is firmly fixed in the matured feather it fades easily when exposed to strong light. Direct sunlight must be avoided. It has been found, too, that it is the actual red of the pepper and not the spicy element that causes the enriched color. Care should be taken to see that the supply of ground sweet pepper used is fresh and clean and that it is not artificially colored. Bathing must not be permitted more often than once a week, and the birds should be disturbed as little as possible. With proper care there will be little trouble in producing fine, healthy birds with a rich, highly colored plumage. This enhanced color lasts only during the continuance of this growth of feathers, and if color feeding is not resorted to at the next molt the canary will again be plain.

BREEDING.

The breeding season for canaries begins properly in March. Though birds often show signs of its approach as early as January, it is better, because of the effect of changing weather conditions upon callow young, to postpone nesting activities until later, if possible. Some canary fanciers keep canaries paired throughout the year, but the more common practice is to separate the sexes except when breeding. The beginning of the mating season is marked by ringing, vigorous song among male birds, accompanied by much restless activity. Females, indifferent until now, respond with loud call notes and otherwise evince their interest. Birds may be paired without these preliminary signs, but usually this tends only to lengthen the breeding season without material benefit. The instinct to breed may be stimulated when necessary by the addition of egg food and green stuff to the diet.

Canaries in captivity are polygamous when opportunity offers, and many breeders place two or even three females with each male. It is usually considered better, however, to keep them in pairs, as they are more readily handled, and when the young are hatched the male is able to assist in caring for them. Where two females are kept with one male the birds should be placed in a cage divided by slides into three compartments. The male is placed in the middle, and a female on either side. During half the day the male is thrown with one female, and during the remainder with the other. This arrangement necessitates the use of three sets of seed and water cups in each cage. When the females begin to incubate the male is removed or excluded from both.

A cage suitable for one pair of canaries should be equipped with a sliding wire partition. The male and the female are placed one in either compartment and the two left to make acquaintance. The male will begin to feed the female through the wires in a day or two, or perhaps at once, and when this is observed the slide may be withdrawn and the birds kept together. If a cage is used that has no slide there is usually some bickering between the birds at first, but birds are rarely found that do not in the end agree. A cage thus used without a slide should be new to both birds, in order that neither may resent the presence of an intruder in a cage which it has been accustomed to consider its own.

Canaries will build in anything that offers support. A nest box of wood, or, better, an earthenware nest pan, may be fastened to the side or back of the cage midway between the two perches. The rush or willow nests sold by many dealers, while serviceable, may harbor vermin. The earthenware nest pan is best, as when the breeding season is over it is readily cleaned and put away for another year. Failing this, a box one inch and a quarter or more deep made of thin wood may be used. The nest box or pan should have a lining or bottom covering of felt. This may be pasted in the earthenware pan, and when it is desired to renew it the covering may be soaked loose without trouble. The nest receptacle, of whatever description, should be suspended an inch above the level of the perches. This prevents the young from leaving the nest too soon. If the nest is not too near the perches the male is not so likely to be obtrusive during incubation.

Soon after pairing the female will be seen carrying feathers in her bill or searching about the bottom of the cage. If a little nesting material is given her she will be content to arrange and rearrange it for a few days. As soon as she shows serious intention of building, enough material for actual nest construction may be supplied. If a considerable quantity is furnished at first it is merely wasted. The material may be held in a small wire rack suspended on the outside of the cage or placed inside. Bits of string, cotton, slender blades of dried grass, dried moss, cow's hair, or other soft material will serve well. No long strings nor long hairs should be given, as these may cause trouble later by entangling the feet and legs of mother and young. Everything furnished should be clean and free from dust. Some canaries are expert nest builders, while others construct a slovenly structure that barely serves to contain the eggs. In some cases they even refuse to build, and it is necessary to construct a nest for them.

The first egg will be deposited from a week to a month after the birds are paired. Normally it is laid in about two weeks. Four or five eggs are the usual number in a setting, but this may vary from three to six. The eggs should be removed as soon as laid. This may be done readily with a teaspoon, with care not to injure the delicate shells. The eggs should be kept in a cool place, slightly embedded in fine corn meal or cared for in some other manner that does not allow them to roll about or touch each other. When it is thought that no more eggs are coming all are replaced in the nest with the last one laid. Removing the eggs and then replacing them postpones incubation and development in those first laid and makes the time of hatching more even. The normal period of incubation is 14 days.

Egg binding sometimes causes trouble and may be dealt with by holding the female with the vent over the steam of hot water. A good method is to fill a narrow-necked jar or bottle with hot water and cover the mouth of the receptacle with cheese cloth; the female is then held carefully for a minute or two in the rising steam. Often the egg will drop at once and be caught in the cheese cloth, or it may be deposited in the normal manner after the bird is returned to the cage.

The male canary is ordinarily a model husband and parent, giving no trouble, but if he should annoy the female during incubation or attempt to injure the young he should be removed at once. It is the natural instinct of an incubating bird to conceal itself as much as possible, and though canaries are tame, this tendency should be recognized and respected. This does not mean that they are to be neglected. Each breeding cage should be equipped with a sand tray which should be cleaned at least every other day. In no other way can it be hoped to rear numbers of birds successfully. Except for this necessary care and the giving of food, water, and bathing facilities, the birds should be bothered as little as possible.

The young birds leave the nest when 20 to 30 days old. They may be left with the parents as long as they are fed and should never be removed entirely until it is found that they are able to crack the seeds upon which they must feed. Sometimes a female preparing a nest for a second brood will pluck the feathers from the young. In such case the young should be placed in a small nursery cage suspended from the side of the breeding cage in a manner that will allow feeding between the wires. When the young are finally removed they must not be placed with birds older and stronger for a time. They should be watched carefully the first day, and if any one does not feed it must be returned to the parents at once. Though most of the losses among canaries come at this time, with care in food and cleanliness there should be little trouble.

SEX AND AGE.

To determine the sex and age in living canaries is difficult and is to be attempted only by one who has had long experience as a canary fancier. The external characters denoting sex are not easily described. In nearly all cases a male may be recognized by his proficiency as a songster, but occasionally female birds also possess a clear, full song. When in breeding condition the sex may be determined readily by examining the vent. In males it is protuberant, while in females it does not project below the level of the abdomen. By daily observation the canary breeder is generally able to distinguish the sexes through slight differences in carriage and mannerisms not apparent to one not familiar with them.

In judging age the feet offer the only characters easily seen, but even these can not always be relied upon. Birds a year old or less usually have the skin and scales covering the feet and tarsi smooth and of fine texture. In older birds they appear coarser and roughened. Very old birds usually have had the claws trimmed until they appear blunt or rounded rather than sharp and pointed (see p. 18).

Canaries have lived many years when cared for regularly and when kept protected from sudden changes of weather and temperature. Dr. C. W. Richmond, Acting Curator of Birds in the United States National Museum, relates that two birds, hatched in the same brood and kept entirely separated after they left the nest, lived 18 years, dying within a few weeks of each other. Another case is on record in which a canary was known to be at least 34 years old when it died, and even this advanced age may have been exceeded. Usually with advancing years birds molt irregularly or lose part of the feathers entirely. Often their eyesight is impaired. It is said that canaries that have not been paired live much longer than those allowed to breed.

VERMIN.

Canaries serve as hosts for two forms of external parasites. The larger of these, a bird louse known usually as the gray louse, is an insect[1] with a slender, elongate body and a large head armed with strong jaws. This pest feeds upon the feather structure of the bird's outer covering and though it does not suck the blood of its host, its sharp claws irritate the skin and cause discomfort to the bird. The eggs of the gray louse are attached to the feathers by a gum and are not easily removed. The young insects resemble the adults and in a few weeks after hatching are fully grown. They are best combated by blowing insect powder (pyrethrum) into the plumage of the affected bird with a small bellows or blower. This treatment should be repeated two or three times at intervals of a week to insure that any young bird lice hatching in the meantime will be killed.

The other parasite of canaries is a small mite, a minute spiderlike creature that when fully grown is barely visible to the unaided eye. Its natural color is whitish, but nearly always it is filled with blood sucked from the body of the unfortunate bird harboring it, so that it appears bright red. These mites are nocturnal and except in cases of severe infestation are seldom found upon the body of their host during the day. They are often found in the slits at the ends of the perches or in the round piece of metal forming the support at the top of the ordinary wire cage. In wooden cages they hide in cracks, nail holes, or crevices, and their presence is betrayed upon close examination by minute white spottings. If unnoticed, they multiply rapidly and sap the strength of the bird by sucking its blood. When their presence is suspected, remove the bird temporarily and either clean the cage thoroughly with a solution of one ounce of commercial carbolic acid in a gallon of water, applied with a small brush, taking care to reach all crevices; or immerse the cage in boiling water, keeping it covered for several minutes. In addition, insect powder may be used as for the gray louse.

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[1] Order Mallophaga.

Where facilities for frequent bathing are offered and the cage is kept clean, there is usually little trouble with either mites or bird lice. When a bird is sick and neglects its customary bathing, cleaning, and preening, it is surprising to see how rapidly these pests multiply. With care, however, they may be completely eradicated, though fresh outbreaks are liable to occur when new birds are brought in.

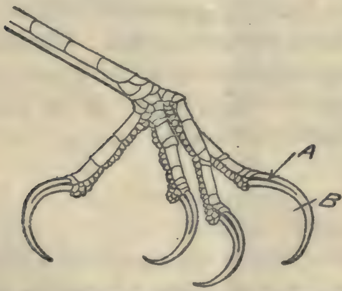

FIG. 5.—Diagram of foot of canary with overgrown claws. A, Terminal blood vessel; B, point at which claw may be trimmed without injury.

CARE OF FEET AND BILL.

As a canary grows old it will be noticed that its claws get long and catch on the perches and wires as it hops about the cage. In a state of nature the activities of the bird as it moves about on the ground or among twigs and limbs keep the claws properly worn down. Confined in a cage, the canary is less active, and while the rate of growth of the claws remains the same they are subject to much less abrasion. It is necessary, therefore, to trim them with a pair of sharp scissors every few months. It is important to watch the condition of the claws carefully, as by catching they may cause a broken leg. In each claw a slender blood vessel extends well down toward the tip (fig. 5). This may be seen on close examination through the transparent sheath of the claw. In trimming cut well beyond this canal and take special care not to break the leg while handling the bird.

In cage birds the horny covering of the bill, as well as the claws, sometimes becomes distorted through growth without sufficient wear. The tips of the mandibles may be pared down with a sharp knife, but care must be taken not to cut deep enough to reach the quick.

BROKEN LIMBS.

In case of bad fractures or injuries it is perhaps best for all concerned to end the troubles by killing the bird. If a valuable bird breaks a leg, a slender splint of wood held by a bandage may be applied with care. This support must not be touched for two or three weeks, but then it may be removed entirely. When the break occurs in the lower leg (tarsus) a small quill makes a simple support. The quill is split and cut down until it fits snugly around the part affected. It is then padded inside with a few shreds of cotton and tied carefully in place with silk thread.

Broken wings should be allowed to heal without outside interference. All high perches should be removed from the cage, and food and water made easily accessible. A bird with a broken wing must be kept as quiet as possible in order that the fracture may heal.

LOSS OF FEATHERS ABOUT HEAD.

Baldness is sometimes occasioned by mites or bird lice and may be treated best by removing the cause. Loss of feathers about the head, however, may indicate old age or general debility. At the natural time of molt the growth of feathers on the bare spots may be aided by warmth and a well-regulated diet. In addition to the usual food, twice a week give a little bread moistened with milk which has been dusted with a mixture of two parts of sulphur to one of potassium chlorate. At the same intervals rub a little carbolized petrolatum on the bare places.

DISEASES.

With ordinary care in cleanliness, freedom from drafts, and a well-regulated food supply, canaries are subject to few ills. In fact, most troubles may be traced to some untoward circumstance in handling them. Their diseases are very little understood, and correct diagnosis is difficult. When birds become sick, care should first be taken in regulating the diet and general sanitary conditions. A sick bird must be removed at once to a separate cage, since its companions will continually peck and worry it. When numbers of canaries are kept it is best to remove ailing birds from the bird room. This precaution may prevent the spread of some contagious or infectious disease. It is always well to move a sick bird to a warm place. Heat and protection from drafts work wonders with ailing canaries and often are sufficient alone to restore them to health.

When medicine is necessary it is best to administer it in the drinking water. If this can not be done it may be given directly in the bill by means of a quill or a medicine dropper. In administering medicines it must be remembered that a canary is small and that a single drop in most cases is a large dose. Indiscriminate dosing of birds with various remedies is to be avoided.

The few instructions that follow are not to be regarded as infallible, but they may be of assistance in simple ailments. When a bird is seriously ill there is usually little chance of its recovery.

RESPIRATORY TROUBLES.

The fact that canaries are susceptible to cold drafts can not be too strongly emphasized, and it may be said that a large proportion of their common ailments come from such exposure. In ordinary colds there is difficulty in breathing and some liquid discharge from the nose. Frequently this is accompanied by coughing. A bird thus affected should be kept in a warm room free from all drafts and protected from irritating dust, vapor, or tobacco smoke. The symptoms are increased as the cold progresses and becomes acute, and the bird sits with feathers puffed out, seeming really ill. Breathing is difficult and rapid. If there is enough catarrhal secretion partly to block the respiratory passages a slight bluish tint is noticed beneath the transparent sheath of the bill. As a remedy, place in the drinking cup 1 ounce of water to which has been added 20 drops of syrup of tolu, 10 of sweet spirits of niter, and 10 of glycerine. As a stimulant in severe cases, from 5 to 10 drops of whisky or brandy may be added to this.

Pneumonia in cage birds often follows exposure and is nearly always fatal. The symptoms, rapid and difficult breathing with little catarrhal discharge, appear suddenly. The bird becomes very weak at once and usually dies in from two to seven days. Little can be done beyond providing an easily assimilated food, as egg food and bread moistened in milk. A few drops of whisky may be added to the drinking water as a stimulant.

Asthma is a chronic affection, in which there is difficulty in expiration of air in breathing. In severe cases a contraction of the abdominal muscles is evident in forcing the air from the lungs. Asthma is more in evidence at night, and often birds apparently free from it during the day will wheeze when at rest. There is practically nothing that can be done for it. Sometimes a semblance of asthma is caused by indigestion from overeating. Fanciers consider asthma hereditary and do not recommend birds so affected for breeding purposes.

INTESTINAL COMPLAINTS.

Intestinal troubles arise in nearly all cases from errors in food or water supply and are avoided by care in feeding. In case of diarrhea, remove all green and soft foods from the cage for a time and give only the normal seed supply. It is well to add a small quantity of epsom salts to the drinking water for a day. If there is no improvement, feed the bird a bit of moist bread, with the surface covered lightly with bismuth (subnitrate), or place an ounce of water in the drinking cup, adding a solution of 3 or 4 drops of tincture of opium and 15 drops of whisky. For constipation the addition of lettuce, apple, chickweed, or other green food to the regular menu is usually sufficient; if not, a pinch of epsom salts may be added to the drinking water. The quantity of the purgative should be enough to impart a faintly saline taste to the solution. Castor oil is not a good corrective remedy for small birds.

When worms are present, as sometimes happens, small fragments of these internal parasites may be seen in the droppings when the cage is cleaned. As a remedy, place in the drinking cup 8 or 10 drops of tincture of gentian in an ounce of water. This may be given for two days, and in addition 2 drops of olive oil may be administered in the bill by means of a medicine dropper.

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HOMEMADE FIRELESS COOKERS AND THEIR USE

PREPARED IN THE OFFICE OF
HOME ECONOMICS

FARMERS' BULLETIN 771

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the States Relations Service
A. C. TRUE, Director

Washington, D. C. December, 1916

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HOMEMADE FIRELESS COOKERS AND THEIR USE.[1]

CONTENTS.

	Page.		Page.
Introduction	3	How to use the fireless cooker	9
How to make a homemade fireless cooker	4	Recipes for use with the fireless cooker	11

INTRODUCTION.

The principle employed in the fireless cooker has long been known and may be briefly stated as follows: If a hot body is protected by a suitable covering the heat in it will be retained for a long time instead of being dissipated by radiation or conduction. In using a fireless cooker the food is first heated on the stove until the cooking has begun and then it is placed in the fireless cooker, a tight receptacle in which the food is completely surrounded by some insulating substance, which prevents the rapid escape of the heat so that it is retained in the food in sufficient quantity to complete the cooking. Sometimes an additional source of heat, such as a hot soapstone or brick, is put into the cooker with the food where a higher cooking temperature is desired. The same principle is also employed in other ways in cookery. For example, in camps beans are often baked by burying the pots overnight with hot stones and ashes, the whole being covered with earth, and in the "clam bakes" on the Atlantic coast the damp seaweed spread over the embers and the clams prevents the escape of the heat during cooking. The peasants in some parts of Europe are said to start their dinner cooking and then put it into hay boxes or between feather beds so that the cooking may be completed while the family is absent in the fields.

One of the chief advantages of the fireless cooker is that it accomplishes a saving in fuel, especially where gas, kerosene, or electric stoves are used. Where coal or wood is the fuel, the fire in the range is often kept up most of the day and the saving of fuel is less. In summer or when the kitchen fire is not needed for heating purposes, the dinner can be started on the stove early in the morning and then placed in the fireless cooker, the fire in the range being allowed to go out. During hot weather the use of a kerosene or other liquid-fuel stove and a fireless cooker is a great convenience, since it not only accomplishes a saving in fuel but helps to keep the kitchen cooler. As would be expected, the saving in fuel resulting from the use of a fireless cooker is greatest in the preparation of foods like stews, which require long and slow cooking.

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[1] Prepared under the direction of C. F. Langworthy, chief, Office of Home Economics.

NOTE.—This bulletin, which represents the results of experience and experiment, is especially adapted to the use of housekeepers who wish simple directions for making and using fireless cookers.

The great convenience of the fireless cooker is that it saves time, for foods cooked in it do not require watching and may be left to themselves while the cook is occupied with other duties, or the family is away from home, without danger from fires or overcooking the food. Its use, therefore, may enable a family to have home cooking instead of boarding, or hot meals instead of cold foods. Another advantage of the use of the fireless cooker is that it makes it easier to utilize cheaper cuts of meat, which, although not having as fine a texture or flavor, are fully as nutritious, pound for pound, as the more expensive cuts. Long cooking at relatively low temperature, such as is given foods in the fireless cooker, improves the texture and flavor of these tougher cuts of meat.

HOW TO MAKE A HOMEMADE FIRELESS COOKER.

While there are many good fireless cookers on the market, it is possible to construct a homemade cooker which, if properly built, will give very satisfactory results and is cheaper than one which is purchased. The materials needed are a box or some other outside container, some good insulating or packing material, a kettle for holding the food, a container for the kettle or a lining for the nest in which the kettle is to be placed, and a cushion or pad of insulating material to cover the top of the kettle.

For the outside container a tightly built wooden box, such as that shown in figure 1, is probably the most satisfactory. An old trunk, a small barrel, or a large butter or lard firkin or tin may be used. Another possibility is a galvanized-iron bucket with a closely fitting cover; this latter has the advantage of being fireproof. A shoe box, 15 by 15 by 28 inches, is convenient in size, since it may be divided into two compartments. The box should have a hinged cover, and at the front side a hook and staple or some other device to hold the cover down; an ordinary clamp window fastener answers the latter purpose very well. Whatever the container used, its size, which depends upon the size of the kettle used, should be large enough to allow for at least 4 inches of packing material all around the nest in which the kettle is placed.

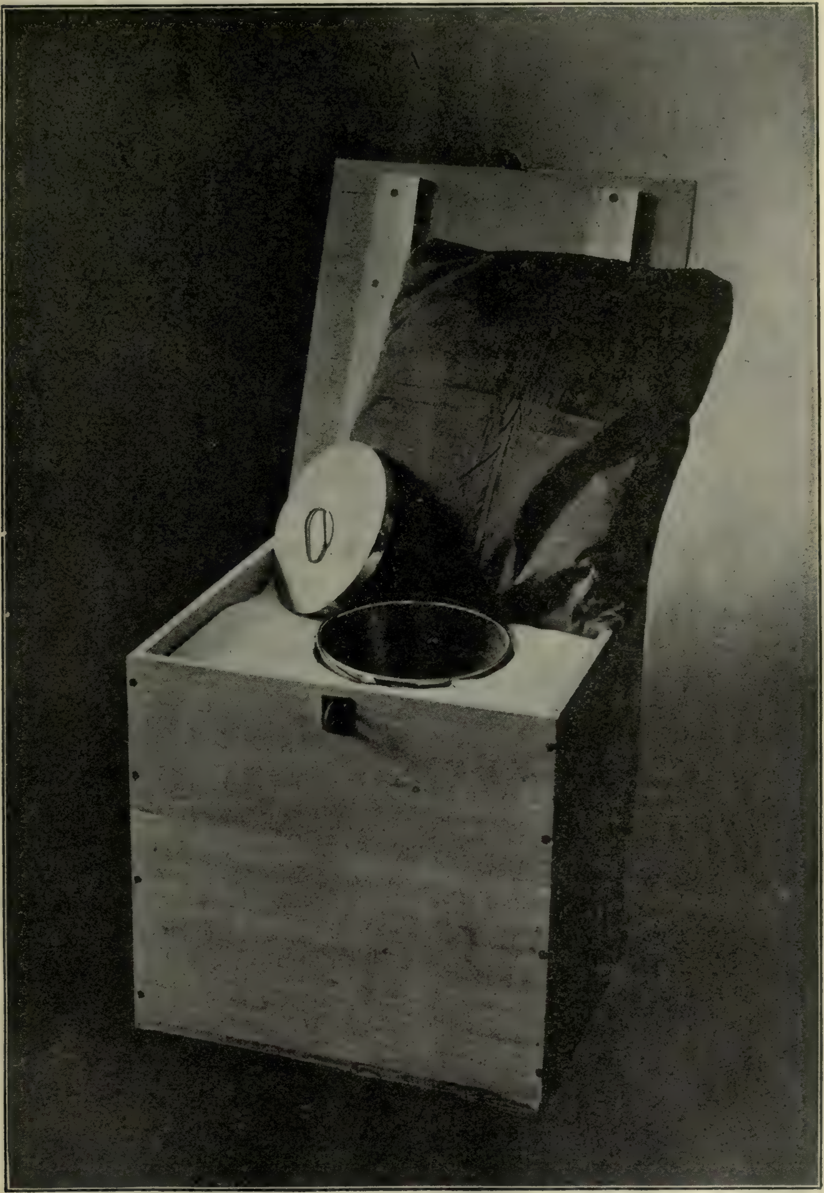

FIG. 1.—Homemade fireless cooker, showing outside container and cushion for filling space above the cooking vessel.

The kettles used for cooking should be durable and free from seams or crevices, which are hard to clean. They should have perpendicular sides and the covers should be as flat as possible and provided with a deep rim shutting well down into the kettle to retain the steam. (See fig. 2.) It is possible to buy kettles made especially for use in fireless cookers; these are provided with covers which can be clamped on tightly. The size of the kettle should be determined by the quantity of food to be cooked. Small amounts of food can not be cooked satisfactorily in large kettles, and it is therefore an advantage to have a cooker with compartments of two or more different sizes. Kettles holding about 6 quarts are of convenient size for general use. Tinned iron kettles should not be used in a fireless cooker, for, although cheap, they are very apt to rust from the confined moisture. Enameled ware kettles are satisfactory, especially if the covers are of the same material. Aluminum vessels may be purchased in shapes which make them especially well adapted for use in fireless cookers and, like enameled ware, they do not rust.

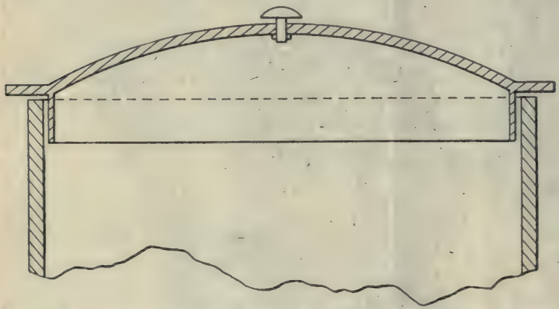

FIG. 2.—Cover provided with deep rim shutting down into the kettle to retain the steam.

Fireless cookers are adapted to a much wider range of cooking if they are provided with an extra source of heat, since a higher cooking temperature may thus be obtained than if hot water is depended upon as the sole source of heat. Obviously this introduces a possible danger from fire in case the hot stone or other substance should come into direct contact with inflammable packing material like excelsior or paper. To avoid this danger a metal lining must be provided for the nest in which the cooking vessel and stone are to be put. As an extra source of heat a piece of soapstone, brick, or an iron plate, such as a stove lid, may be used. This is heated and placed in the nest under the cooking vessel; sometimes an additional stone is put over the cooking vessel.

The container for the cooking vessel, or the lining for the nest in which it is to be put, should be cylindrical in shape; should be deep enough to hold the cooking kettle and stone, if one is used; and should fit as snugly as possible to the cooking vessel, but at the same time should allow the latter to be moved in and out freely. If the cylinder is too large the air space between it and the kettle will tend to cool the food. For this purpose a galvanized iron or other metal bucket may be used or, better still, a tinsmith can make a lining of galvanized iron or zinc which can be provided with a rim to cover the packing material (as shown in fig. 3). In case no hot stone or plate is to be used in the cooker, the lining can be made of strong cardboard.

For the packing and insulating material a variety of substances may be used. Asbestos and mineral wool are undoubtedly the best, and have the additional advantage that they do not burn. Ground cork (such as is used in packing Malaga grapes), hay, excelsior, Spanish moss, wool, and crumpled paper may also be used satisfactorily. Of the inexpensive materials that can be obtained easily, crumpled paper is probably the most satisfactory, since it is clean and odorless and, if properly packed, will hold the heat better than some of the others. To pack the container with paper, crush single sheets of newspaper between the hands. Pack a layer at least 4 inches deep over the bottom of the outside container, tramping it in or pounding it in with a heavy stick of wood. Stand the container for the cooking vessel, or the lining for the nest, in the center of this layer and pack more crushed papers about it as solidly as possible. The method of packing with paper is illustrated in figure 4. If other packing, such as excelsior, hay, or cork dust, is used, it should be packed in a similar way. Where an extra source of heat is to be used, it is much safer to pack the fireless cooker with some noninflammable material, such as asbestos or mineral wood. A cheap and easily obtained substitute are the small cinders sifted from coal ashes, preferably those from soft coal, which may be obtained at the boiler house of any mill. The cinders from hard coal burned in the kitchen range will do, however. Experiments with this material made in this office showed that it is very nearly as satisfactory as crumpled paper as a packing material. If a fireproof packing material is not used a heavy pad of asbestos paper should be put at the bottom of the metal nest and a sheet or two of asbestos paper should be placed between the lining of the nest and the packing material. Whatever packing material is used, it should come to the top of the container

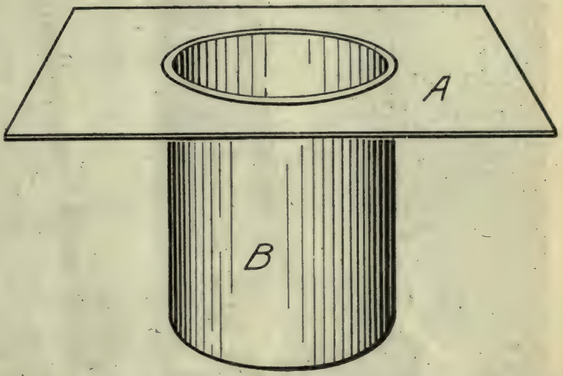

FIG. 3.—Metal lining for nest of fireless cooker: *A*, Rim to cover packing material. *B*, Metal container for cooking kettle and hot stone.

for the kettle, and the box should lack about 4 inches of being full. A cushion or pad must be provided to fill completely the

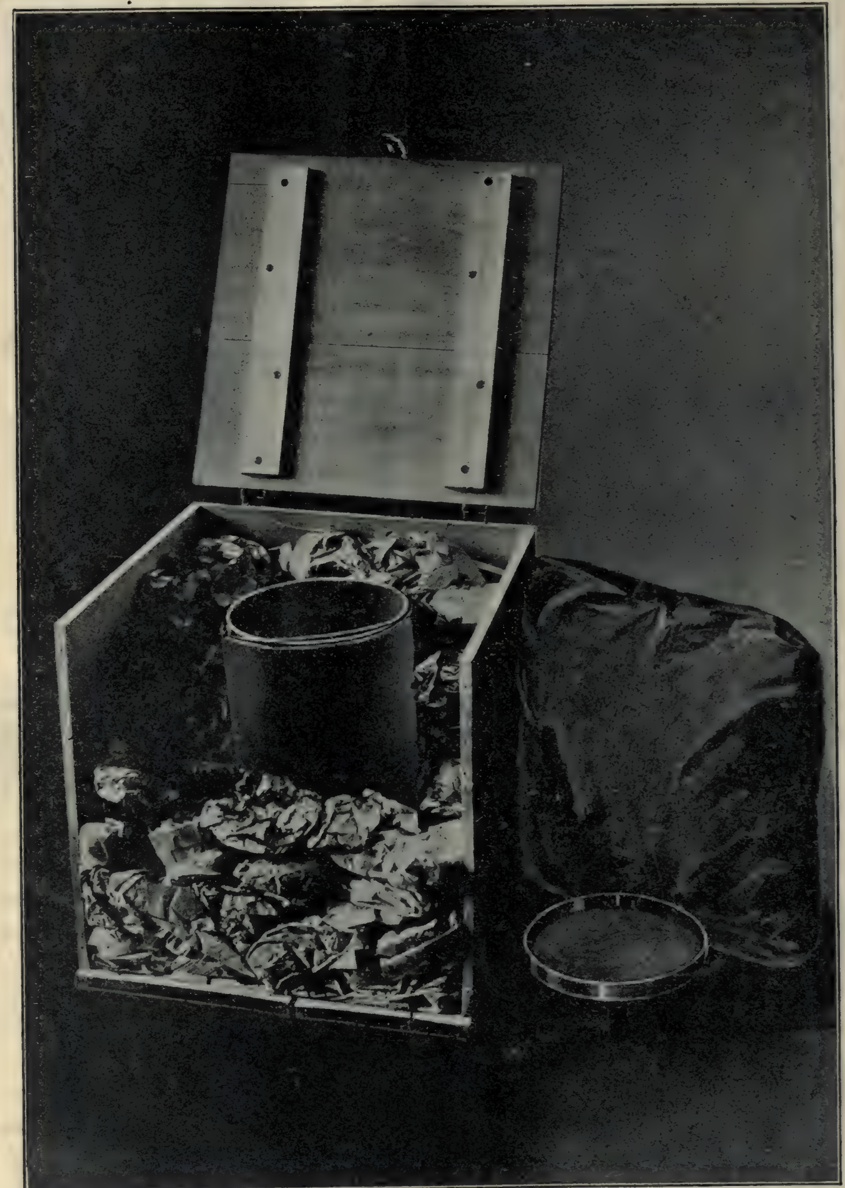

FIG. 4.—Homemade fireless cooker with part of outside container removed to show packing of crumpled paper and the cooking vessel, with its container.

space between the top of the packing and the cover of the box after the hot kettles are put in place. (See fig. 1, p. 5.) This should be made of some heavy goods, such as denim, and stuffed with cotton, crumpled paper, or excelsior. Hay may be used, but will be found more or less odorous. Figure 5 shows the vertical cross section of a home-made fireless cooker.

HOW TO USE THE FIRELESS COOKER.

Obviously the fireless cooker must be used with intelligence to obtain the best results. It is best suited to those foods which require boiling, steaming, or long, slow cooking in a moist heat. Foods can not be fried in it, pies can not be baked successfully in the ordinary fireless cooker, nor can any cooking be done which requires a high, dry heat for browning. Meats, however, may be partially roasted in the oven and finished in the cooker, or may be begun in the cooker and finished in the oven with much the same results as if they were roasted in the oven entirely. The classes of food best adapted to the cooker are cereals, soups, meats, vegetables, dried fruits, steamed breads, and puddings.

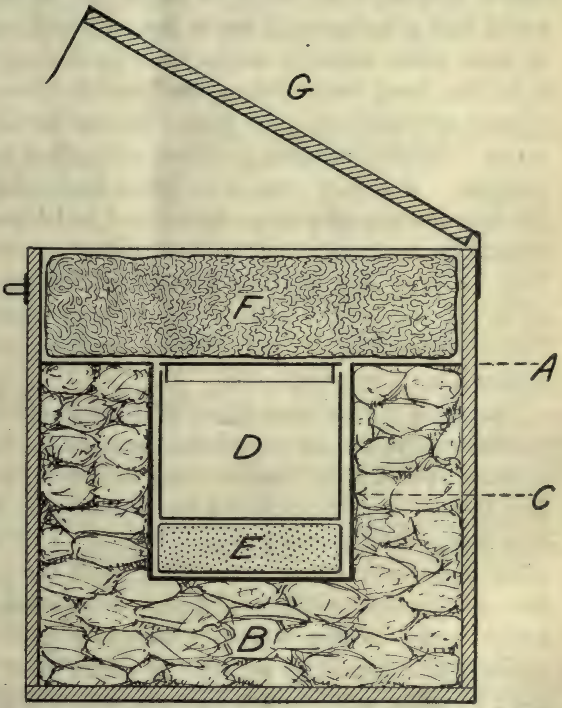

FIG. 5.—Longitudinal section through fireless cooker, showing details of the construction: *A*, Outside container (wooden box, old trunk, etc.) *B*, Packing or insulating material (crumpled paper, cinders, etc.). *C*, Metal lining of nest. *D*, Cooking kettle. *E*, Soapstone plate, or other source of heat. *F*, Pad of excelsior for covering top. *G*, Hinged cover of outside container.

When different foods are cooked together in the fireless cooker they must be such as require the same amount of cooking, since the cooker can not be opened to take out food without allowing the escape of a large amount of heat and making it necessary to reheat the contents. It would not do to put foods which need about one and one-half hours to cook into the cooker with a piece of meat which would stay several hours.

The size of the container used in cooking with the fireless cooker should be governed according to the amount of food to be cooked. Small quantities of food can not be cooked satisfactorily in a large kettle in the fireless cooker. If a large kettle must be used better results will be obtained if some other material which holds heat fairly well is used to fill up the empty space. This may be accomplished in several ways. One is to put the small quantity of food to be cooked into a smaller, tightly closed kettle, fill the large kettle with boiling water and put the small kettle into it, standing it on an inverted bowl or some other suitable support. This boiling water will take up and hold the heat better than air would. Several smaller dishes (if tightly covered) may be placed in the kettle surrounded by boiling water. Baking-powder or other tins often are found useful for this purpose. Another way is to place one food in a basin which just fits into the top of a large kettle and to let some other material, some vegetable perhaps, cook in the water in the bottom of the kettle. Two or more flat, shallow kettles placed one on top of the other so as to fill the cooker enable one to cook small amounts of different foods successfully. Such kettles, made especially for use in fireless cookers, may be purchased.

The time which each kind of food should stay in the cooker depends both on the nature of the food and on the temperature at which it remains inside the cooker, and before recipes for use with the fireless cooker can be prepared one must have some means of knowing how temperatures are preserved in it. In experiments made in this office a 6-quart kettle was filled with boiling water and put into the cooker, the packing of which happened to be newspaper. The temperature of the water, which was 212° F. when put into the cooker, was found to be 172° F. after four hours had elapsed and 155° F. after eight hours had elapsed. This shows the advisability of the common custom of allowing food to remain undisturbed in the cooker for at least six or eight hours, or in some cases overnight. If a soapstone, hot brick, or other extra source of heat is used, less time will be required. Materials which are denser than water (sugar sirup as used in cooking dried fruit), and therefore can be heated to a higher degree, will keep up the temperature longer when put into the cooker. Thus the density of the food material, as well as the amount and the length of time that the apparatus retains the heat, must be taken into consideration in determining how long different materials must be cooked in the cooker.

The recipes for dishes to be prepared in the fireless cooker differ somewhat from those for foods cooked in the ordinary way, chiefly in the amount of water or other liquids called for. Less liquid should be put into the food to be prepared in an ordinary fireless cooker, since there is no chance for water to evaporate. The cook must be guided largely by experience in deciding how long the food should be heated before being put into the cooker and how long it should be allowed to remain there. Fortunately there are several good fireless cookbooks on the market whose directions can be relied upon, and at the end of this publication several selected recipes are given.

RECIPES FOR USE WITH THE FIRELESS COOKER.

The following recipes, prepared by Miss Ola Powell and Miss Mary E. Creswell, have been used in extension work in the Southern States.

Creole Chicken.

1 medium-sized chicken.
6 tomatoes or 1 No. 2 can tomatoes.
3 sweet red peppers cut into small cubes.
3 sweet green peppers cut into small cubes or 1 No. 2 can of peppers.
¼ pound ham or 2 or 3 slices bacon chopped finely.
1 bay leaf.
1 tablespoon chopped parsley.
2 teaspoons salt.
1 onion (size of egg).
2 tablespoons butter or bacon drippings

Cut chicken as for stew; sear by dropping it into 1 pint boiling water, then let simmer gently for one-half hour.

Cook the chopped onion in the butter or meat drippings until light yellow. Simmer tomatoes for 15 minutes with the bay leaf, strain, and pour over the onions. Now add the minced ham and parsley and cook for 15 minutes longer. To this mixture add the chopped peppers and the chicken stock and bring to a boil. Put the chicken into the fireless-cooker vessel, pour over it this mixture of vegetables and let boil 5 minutes. Put at once into the fireless cooker. With the hot soapstone, let the chicken stay in the cooker for 2 hours; without hot stone, for 3 hours.

A ham bone may be substituted for the ham or bacon. If this is done, boil it for one-half hour in enough water to cover. Then add 1 cup of the ham broth to the tomato before cooking it with the bay leaf. This recipe gives a good way to use chicken too old to fry or broil. A similar dish can be made by using a quart of canning club soup mixture. When necessary, thicken the broth with a little browned flour before putting the chicken into the cooker.

CEREALS.

Hominy grits.—Five cups water, 2 teaspoons salt, 1 cup hominy grits. Pick over and wash hominy grits. Have the salted water boiling and add the hominy slowly, so as not to stop the boiling. Continue to boil rapidly for 10 minutes over the fire, then put the vessel into the cooker as quickly as possible and allow to remain (overnight) for about 12 hours. The vessel of hominy may be placed in another vessel of boiling water before being placed in the cooker.

Samp (coarse hominy).—One-half cup samp soaked in 1 cup cold water 6 hours. Add 1½ teaspoons salt and 3 cups boiling water. Boil rapidly 45 minutes. Put into cooker for 8 to 12 hours.

Oatmeal.—Three cups water, 1 teaspoon salt, 1 cup oatmeal. Carefully look over the oatmeal and remove any husks or foreign substance. Add gradually to the boiling salted water and boil rapidly for 10 minutes, stirring constantly. Now it may be put into the cooker. After 2 or 3 hours it is soft, but a better flavor will be developed by longer cooking. It may remain in the cooker overnight in the same manner the hominy grits are cooked (about 12 hours). Next morning it may have to be reheated. To do this, set the cooker pan in a pan of water over the fire. When the water boils up well, the oatmeal may be served.

Plain rice.—One cup rice, 3 cups water, 1½ teaspoons salt. Look over and wash the rice through several waters, until cloudiness is removed. Bring the salted water to a boil. One-half teaspoon lard may be added. Then add rice gradually to the boiling water in the cooker vessel so as not to stop the boiling. The grains should be kept moving in the boiling water and allow to boil 5 minutes before putting it into the cooker for 45 minutes or an hour.

There is a considerable difference in rice. Old rice absorbs more water than new rice and the time for cooking it will vary. An hour will be sufficient usually for this small amount. Rice is injured by overcooking. When rice is tender, drain in colander and place in warm oven for about 5 minutes. Serve at once. Sometimes it is well after draining rice in colander to pour cold water over it. This will wash away the starchy substance between the grains, and keep them from adhering or sticking together. Then place the colander in a hot oven to heat and dry out the rice. If desired the lard may be omitted. It lends a brilliancy to the rice grains when cooked.

Rice in pilaf (an oriental mixture).—Two cups stock, 1 cup rice, 2 tablespoons butter, 1 teaspoon sugar, 2 slices onion, 6 ripe tomatoes or 1 cup canned tomato juice, 1 teaspoon salt, ⅛ teaspoon pepper, 1 tablespoon chopped green sweet pepper may be added.

Look over and wash the rice. Chop the onion very finely and fry in 1 tablespoon of the butter until yellow. Add to it the boiling juice of the tomatoes and the boiling broth and allow all to boil before adding the rice gradually so as not to stop the boiling. Boil mixture about 5 minutes and place in cooker 1 hour. When ready to serve, add 1 tablespoon butter. Stir with a fork to mix evenly. Pilaf is injured by overcooking.

SOUPS.

Vegetable soup (made without stock).—One-half cup carrots, ½ cup turnips, 1 cup potatoes, ½ cup onions, ½ cup cabbage, 3 cups tomato juice or 1 No. 3 can tomatoes, 1 tablespoon flour, 2 teaspoons salt, 1 tablespoon celery seed (crushed), 1 quart water, 4 tablespoons butter, ½ tablespoon parsley, ¼ teaspoon pepper.

Cut all vegetables (except potatoes and onions and parsley) into small pieces. Cook them for 10 minutes in 3 tablespoons butter. Add potatoes and cook 3 minutes longer. Mix all ingredients (except parsley) in the cooker utensil and boil 5 minutes. Mix 1 tablespoon butter and 1 tablespoon flour; add enough of the liquor to make it smooth and pour it into the mixture. Cook 5 minutes more and put into the cooker for 4 to 6 hours.

Creole soup (made with stock).—Stock: Two pounds shin beef (meat and bone), 1½ quarts water. Cut the meat from the bone into small pieces. Crack the bone and soak 1 hour in cold water. Bring to a boil slowly and when boiling place in the cooker for 5 to 7 hours. When cooked, strain and set away to cool. The cake of fat which forms on top when stock is cold seals the stock and keeps out air and germs and should not be removed until soup is to be made. Then fat is removed and stock heated and any seasonings or additions desired are put in.

To 1 quart of this stock or 1 quart water in which chicken has been cooked, add 1 quart of canned soup mixture and 2 tablespoons rice or barley, bring to a boil and cook in cooker 2 to 3 hours. This will make a delightful soup.

Meat and vegetable combinations.—With the less tender cuts of beef and mutton which require long, slow cooking, delicious dishes may be prepared by adding vegetables and cooking in the fireless cooker.

Cut the meat into cubes, dredge with flour, and brown it in meat drippings or lard and butter. Then brown the onions in the same fat. For every 3 or 4 cups of meat use one of the following vegetable combinations or 1 quart of canning club soup mixture. Put into the fireless cooker vessel and add 1 cup boiling water with the first combination or 2 cups water with the second one. Boil for 5 minutes and put into cooker for 3 or 4 hours.

FIRST.	SECOND.
2 cups okra.	2 cups potatoes.
2 cups tomatoes.	1 cup turnips.
2 onions.	1 cup carrots.
1½ teaspoons salt.	2 onions.
⅛ teaspoon pepper.	½ cup celery or 1 tablespoon celery seed, crushed.

The following recipes, prepared by Mrs. K. C. Davis and Miss Angeline Wood, have been used in demonstrations in connection with the extension work in the Northern and Western States:

CEREAL BREAKFAST FOODS.

Cereal breakfast foods should be prepared at night while the fire for supper is hot. Measure the required quantity of boiling water into the cooker kettle; add salt and cereal; let boil 10 minutes and place in box overnight. Reheating in the morning will probably be necessary. In winter enough for two or three breakfasts may be cooked at once and reheated as wanted. The food in the inner kettle should be cooked about five minutes before placing in the outer kettle. Then the whole should stand over the flame until the water boils in the outer kettle. Any other kind of breakfast cereal may be cooked by adopting these general directions.

The raw cereal breakfast foods, such as plain oatmeal, hominy, cracked wheat, etc., cost less than those which are partly cooked by steam at the factory, but frequently housekeepers prefer not to use them because they require so many hours of cooking. A cooking box, however, is especially well adapted for cooking just this sort of material. Even the cereal preparations which are partly cooked at the factory and are supposed to need only a few minutes cooking to make them ready for the table are much improved by long, slow cooking such as they get in the cooking box. The flavor and texture of cereal breakfast foods are influenced by the length of time they are cooked, and with the cooking box it is easily possible to secure the texture and flavor dependent upon long, slow cooking.

SOUPS.

The cheap cuts of meats are rich in the food materials that make palatable dishes, and the bones and scraps are good for making wholesome soup. If care is taken to use material which might otherwise be wasted, the real expense for most meat soups is in the long cooking required. The long-continued, slow cooking which a tough piece of meat obtains in the cooking box and the thorough extraction to which bones and soup meat are subjected mean that the cooking box makes stews, ragouts, and similar dishes and soups cheap foods for the table. American families do not, as a rule, use as much soup as do foreigners, and thus they miss a useful and pleasant addition to the daily bill of fare, and one which may be served without much extra work or expense, if rightly prepared.

For making soup stock or broth with the cooking box, the soup bones should be well split up, or the soup meat should be cut into small pieces. Wash the meat, place it in the kettle, and cover with cold water. Bring to a boil on the stove and boil 15 minutes. Do this at night if the soup is to be used at noon the next day. Place in the cooker overnight. In the morning remove meat and bones from soup. Strain and remove fat. Return soup and meat to kettle, adding whatever seasoning is desired. Bring to a boiling point again and return it to the box and let remain until noon. This stock may be used as a foundation for several soups, such as vegetable soup, clear soup, or noodle soup.

Beef soup may be varied almost infinitely by the different seasonings which may be added. There is scarcely a vegetable grown which is not good in beef soup. In winter many of the dried vegetables, such as beans, peas, lentils, etc., are excellent for this purpose.

Dried Lima beans, peas, and lentils make excellent soup without meat. Since they require long-continued cooking, they are well adapted to fireless-cooker methods. These dried vegetables, cooked with less water and no meat, rubbed through a coarse sieve and made into the proper consistency with milk or thin cream, and seasoned to taste, make so-called "cream" soups. Soups made by thinning the cooked legumes with water and seasoning with onion (fried until pale brown), with celery tops, and other vegetables are very palatable also.

MEATS.

Some cuts of meats which are not so readily prepared for the table by the usual methods are especially palatable if cooked in the cooking box. The experimenter will soon learn that in cooking meats the amount of boiling over the flame and the time in the box will depend upon the size of the pieces of meat being cooked. Meat cut into pieces for stew will heat through more readily and cook in a shorter time than will a large ham, for example. Most recipes for stews, pot roasts, boiled meats, and similar dishes can be readily adapted to the fireless cooker and save time and fuel. The following recipes are all well adapted to the cooking box, as all of them are dishes which require considerable time for their preparation by the usual methods.

Pot roast.—Use any preferred cut. Sear in hot fat in a skillet. Place the meat in the cooker kettle and cover with boiling water. Boil gently for 30 minutes (20 minutes will suffice if the roast is 3 pounds or less). Place in the cooker over night. Reheat in the morning, season, and return to the cooking box until noon. Thicken some of the liquor for gravy. If it is desired to slice cold for next dinner, return meat to liquor and let stand until wanted.

Brown fricassee of chicken.—Joint the chicken and brown in fat after rolling in flour. As pieces brown pack them in the kettle. When all are browned make gravy in the skillet where the browning was done. Add this to the chicken with enough boiling water to cover. Salt and pepper. Boil 20 minutes. Place in box over night. Reheat and return to box until noon. This length of time in the box will reduce the toughest old fowl on the farm to a state where the meat will fall from the bones.

Roast meat.—Prepare a 4-pound rib roast as for oven roasting. It can be tied more compactly if the ribs are removed. Place in pan in very hot oven for half an hour, or sear the roast until brown in a frying pan and then place it in the oven for 20 minutes. Have ready a small pail into which the roast will fit as closely as possible. Place the seared and heated roast in this and set it into the large kettle used in the box, with enough boiling water to come well up around the small pail. Place in the box for three hours.

Roasting tough poultry.—Many housewives make a practice of stewing chicken or turkey which they think is likely to be tough, and the practice is a good one. It is, however, much easier to boil for 15 or 20 minutes and then put the fowl, boiling hot, into the cooker and let it remain 10 hours. It should then be drained, wiped dry, and stuffed, if stuffing is desired, and roasted long enough to brown it well.

Boiled dinner.—Cook a piece of corned beef and a piece of salt pork in the cooker overnight. In the morning prepare all the vegetables it is desired to use and place in the kettle with meat. The greater the variety the better the dinner. Boil 10 or 15 minutes and return to the cooker. It is best to leave potatoes until an hour and a quarter before serving, as they are the only vegetables likely to suffer from too long a time in the cooker. When they are added bring the contents of the kettle to the boiling point again. The liquid from the boiled dinner makes a good soup if the corned beef and salt pork have been parboiled to remove some of the salt.

FRESH VEGETABLES.

Carrots, peas, string beans, onions, beets, turnips, parsnips, salsify, and in fact all vegetables may be cooked in the cooking box. They must be given time according to their age. A safe rule for all green vegetables is two and a half times as long in the cooker as if boiled on the stove. This method is particularly good for such vegetables as onions, cabbage, and cauliflower, as there is no escape of odor from the cooker. A further advantage with cabbage, cauliflower, and other green vegetables is that overcooking is avoided. When green vegetables are cooked too long in boiling water they turn yellow and lose their fine flavor. This they do not do so readily at the same temperature of the cooking box.

Boston beans and other dried vegetables.—In cooking dry beans, the time required either in the oven or the cooking box will vary with the length of time the beans have been kept; the older the beans the more cooking required. Soak 1 quart of beans over night; in the morning drain them and cover with cold water and heat to boiling. Let boil until the skins will burst when touched very lightly, adding one-fourth teaspoon of soda a few minutes before taking from the fire. Drain through a colander. Return to the kettle and add 1 teaspoon of salt, 1 teaspoon of mustard, 3 tablespoonfuls molasses, and one-half pound of salt pork, washed and scraped, and cover with boiling water. Let boil 20 or 30 minutes, then place in the cooking box. If the beans are new, six hours in the box will be long enough. Old beans require longer cooking and should be left in the box overnight, then reheated in the morning, and returned to the box. They will be ready to serve for the midday meal.

Dried vegetables, such as peas, beans, Lima beans, lentils, or corn may be soaked in cold water several hours, and then after the preliminary boiling of a few minutes kept from 6 to 12 hours in the cooker. They may be cooked with salt pork, and thus prepared they are liked by many, or they may be cooked with vegetable oil, as olive oil, or they may be cooked plain and seasoned with salt, pepper, and butter or cream. The longer, then, dry vegetables are cooked in the box the more palatable and the more digestible they will be.

DRIED FRUITS.

In the case of dried fruits as well as dried vegetables long continued, slow cooking is desirable. A common method is as follows: Wash the fruit well and let it soak in cold water until it has regained its natural size, and then place on the back of the range and allow it to remain there for 20 hours, but do not allow it to boil. When fruit is cooked in the cooking box, it should be washed and soaked in the way described, heated in the water in which it has been soaked, not quite to the boiling point, and then placed in the cooker for five or six hours. Because less water evaporates than when cooking on the stove, a smaller proportion of water will be needed for good results. If too much is used the sirup will not be quite so rich as usual. Fruit should always be cooked in an enamelware or an earthenware dish, as tin or iron may impart an unpleasant flavor to acid fruit, and also give it an undesirable color.

PUDDINGS AND STEAMED BREADS.

Steamed or boiled puddings, or such as require long, slow cooking, and steamed bread, like Boston brown bread, are the kinds best adapted to the cooking box. Every family has its favorite recipes and these may be used, as the method of procedure is the same for cooking all such foods.

The steamed or boiled puddings or breads should be placed in molds well buttered. For this purpose pound baking-powder cans are excellent. Coffee cans or other tin boxes of suitable size with covers will do. After filling about two-thirds full to allow for the expansion or rising of the batter or dough, the cans are placed in the cooker kettle and should have the covers put on before the boiling begins. If any covers are missing, paper may be tied tightly over the tops. If there are not enough cans to fill the kettle so that they will not tip over when the boiling water is poured around them, an empty can or two may be wedged in, to hold the others in place. Fill the kettle as full as possible with boiling water, as the more water the longer the heat will be retained. Place the kettle on the stove and boil for a full half hour and then keep the kettle and contents in the cooking box three to six hours, or longer if the cans are large ones. This applies particularly to breads or puddings made with wheat flour. If they contain cornmeal or graham flour they should be cooked for a longer time in the cooker.

On removing from the cooker it is a good plan to set the loaves of bread in a hot oven for 10 minutes to dry them a little.

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CONTROL OF
THE SUGAR-BEET NEMATODE

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FARMERS' BULLETIN 772

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. **December, 1916**

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO DISEASES OF SUGAR BEETS AND SOME OTHER CROPS.

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Sugar-Beet Growing under Irrigation. (Farmers' Bulletin 567.)
Sugar-Beet Growing under Humid Conditions. (Farmers' Bulletin 568.)
Leaf-Spot, a Disease of the Sugar Beet. (Farmers' Bulletin 618.)
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Nematodes and Their Relationships. (Separate 652, from Yearbook 1914.)

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The Curly-Top of Beets. (Bureau of Plant Industry Bulletin 181.) Price, 15 cents.
Root-Knot and Its Control. (Bureau of Plant Industry Bulletin 217.) Price, 15 cents.
The American Beet-Sugar Industry in 1910 and 1911. (Bureau of Plant Industry Bulletin 260.) Price, 25 cents.
The Nematode Gallworm on Potatoes and Other Crop Plants in Nevada. (Bureau of Plant Industry Circular 91.) Price, 5 cents.

CONTROL OF THE SUGAR-BEET NEMATODE.[1]

CONTENTS.

	Page.
Description and life history of the sugar-beet nematode	3
The beet nematode in Europe	6
The beet nematode in the United States	7
Effects of beet-nematode attacks	7
Differences between the beet nematode and the root-knot nematode	10
Conditions favorable to the beet nematode	11
Methods of spreading the pest	12
Plants subject to attack by beet nematodes	13
Plants not subject to attack	14
Ineffective methods of combating the nematode	15
How to fight the beet nematode	15
Crops available for rotation on infested land	17
Preventing the further introduction of the beet nematode	18
Breeding or selecting resistant beets	18
Summary	18

AMONG the serious pests that have done much injury in European countries, one of the worst is the sugar-beet nematode,[2] or eelworm, as it is more popularly called, on account of its resemblance to an eel. This eelworm has been found in the principal beet districts of Germany, Austria-Hungary, western Russia, Holland, Belgium, France, Denmark, and Sweden, as well as the Azores, in all of which regions it has caused immense losses.

Unfortunately, the sugar-beet nematode already has gained entrance into the United States. For this reason information should be available at once to aid in its control and to check its further introduction and spread.

DESCRIPTION AND LIFE HISTORY OF THE SUGAR-BEET NEMATODE.

There are numerous kinds of eelworms; many of them are very injurious; some infest animals and others attack plants.

The sugar-beet eelworm is known in six forms, or stages: (1) The egg, (2) the first larval stage, (3) the second larval stage, (4) the adult male, (5) the adult female, and (6) the so-called brown cyst, or preservation form. (Fig. 1.)

The egg.—The female can produce from 350 to 400 microscopic, colorless, oval or kidney-shaped eggs. These are so small that 350 of them placed end to end would extend only 1 inch; their width is about half their length.

The larval stages.—The young eelworm, or larva as it is called, that hatches from each of these eggs is an exceedingly fine, threadlike, active, colorless creature. It tapers at each end and possesses mouth parts armed with a spear, which the worm can dart back and forth rapidly and continuously. This is known as the first larval stage. (Fig 1, *A*.) It averages only one-seventieth of an inch in length; its thickness is about one-twentieth of its length. It is so

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[1] Scientific name, *Heterodera schachtii* Schmidt.

[2] Nematode means threadworm and is the name in use in scientific circles for the numerous species of minute eelworms.

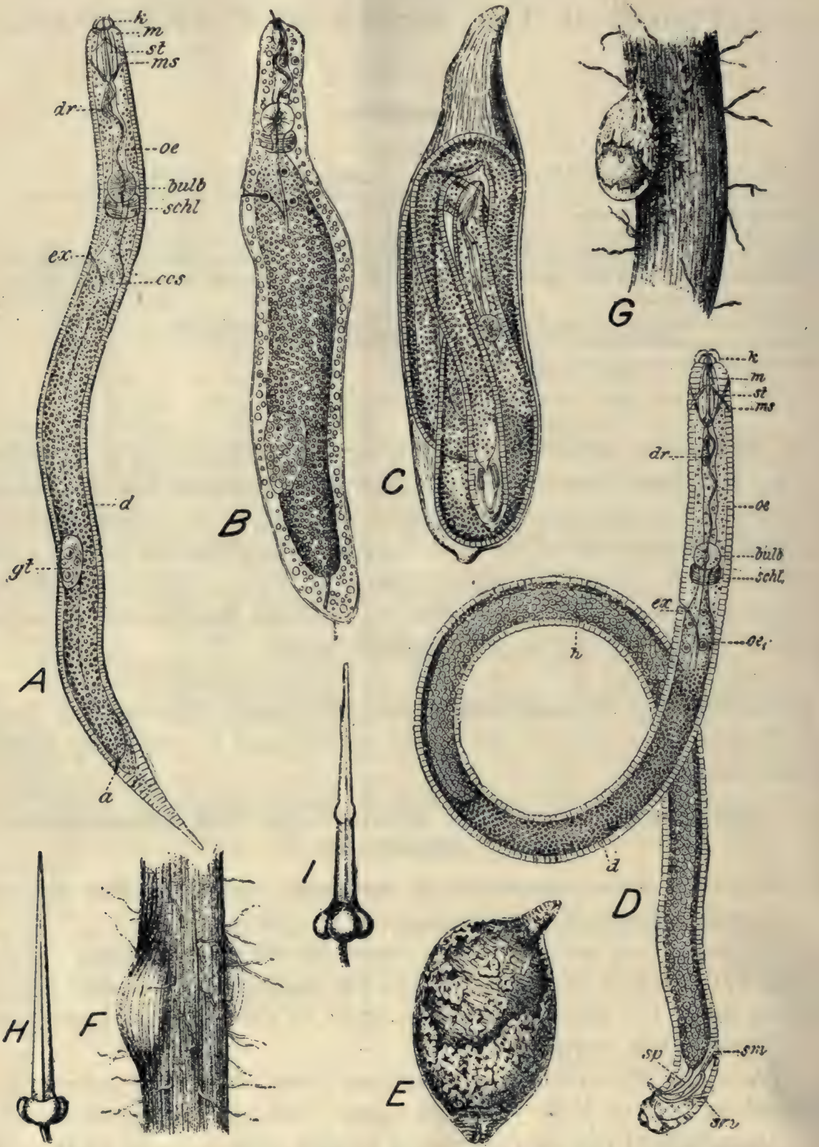

FIG. 1.—The sugar-beet nematode (*Heterodera schachtii* Schmidt): *A*, The first-stage larva, ×200; *B*, the second-stage larva; *C*, the second-stage larva, showing the young male adult beneath the larval skin; *D*, the adult male, ×330; *E*, the adult female, ×30; *F*, a rootlet with swellings caused by larvæ embedded in the tissues, ×15; *G*, the body of an adult female protruding from a beet rootlet, ×15; *H*, the larval spear, ×1,440; *I*, the spear of the adult, ×1,440. (After drawings by Strubell.)

active that it can travel as far as 10 feet, or about 8,400 times its own length, in two weeks, in search of suitable food plants. On finding a rootlet, it forces its way into the outer tissues with its strong, rapidly moving spear. It then feeds on the plant juices. Up to this time the sex of the larva can not be distinguished.

Shortly after entering the tissues of the rootlet it undergoes certain changes, molts, and assumes the flask form, or second larval stage. (Fig. 1, *B*.) Finally, it molts again, to become an adult male or female. The sex can be distinguished some little time before the second molting. (Fig. 1, *C*.)

The adult male.—If the second-stage larva proves to be a male, on emerging from the larval skin he will at once proceed to break his way from the rootlet by means of the stronger spear with which he is now equipped. On escaping from the rootlet he seeks a female, and after fertilizing her he dies. The adult male is considerably larger than the larva, being about one twenty-fifth of an inch long and about one-thirtieth as thick. (Fig. 1, *D*.)

The adult female.—Should the second-stage larva chance to be a female, she rapidly undergoes changes in form; her body becomes enlarged, almost lemon shaped, until it bursts the outer portion of the rootlet in which she was embedded and protrudes from it. (Fig. 1, *G*). She remains thus after being fertilized, with only her head parts attached to the rootlet, until she is fully matured and the eggs are ready to hatch. Her length is about one-twentieth of an inch. Her body is of a pale yellowish white tint. When fully matured, she dies and drops from the rootlet. (Fig. 1, *E*.) If conditions then are favorable the eggs begin to hatch and the young eelworms travel in search of suitable roots upon which to feed.

From the egg of one generation to that of another the time occupied is only four or five weeks. As many as seven generations may come into existence in a single season.

The brown-cyst stage.—The term "brown cyst" was applied by the discoverer of the preservation form of the sugar-beet eelworm because it so well describes its appearance. A cyst is simply a small bladderlike bag, or sac.

A knowledge of certain facts concerning the brown cyst is important, because it may suggest means of preventing the further introduction and spread of the pest, as well as indicate methods of controlling it.

It was formerly believed that no further change took place in the development of the female after she had reached maturity and eggs had been formed within her lemon-shaped body. It was thought that all adult females then died and, if the weather remained sufficiently mild, the eggs hatched and the young eelworms escaped from the dead body to infest other plants, and that if severe weather prevailed when the female died, most of the eggs and young were destroyed. However, it was discovered that on the approach of cold weather, or when other conditions arise that are unfavorable to the female nematodes, many of them undergo further changes. The coverings of the lemon-shaped body gradually become thicker and tougher and assume a dark-brown color. This thickening and toughening is a protective process. When this stage has been reached the female no longer shows any sign of life; her body has become a protective sac, within which the eggs are protected and preserved from outside injurious influences. The brown cysts remain loose in the soil, the rootlets from which they fell having rotted.

The brown cyst is the preservation form of the sugar-beet eelworm. It remains unchanged throughout the winter, protecting the eggs until returning warm weather causes them to hatch. In many instances it was found that the eggs contained in the brown cyst hatch out a few at a time during a period that may extend over several years until nothing remains but the empty, tattered remnants of the cyst. This accounts for the fact that sugar-beet eelworms have been known to persist in ground from which all food plants have been carefully kept for several years.

Although the cold of winter appears to be unable to injure eggs protected by the brown cyst, they may be injured by undue heat; in fact, the entire contents of the cyst can be destroyed by an exposure for one minute to a dry heat of 145° F. A much lower temperature will kill the nematode in any other stage of its existence.

THE BEET NEMATODE IN EUROPE.

Rather early in the history of the beet-sugar industry of Europe it was seen that beets in certain fields or portions of fields became very sickly in appearance and attained only a small size. This condition became more and more general, until it had reached such alarming proportions as to cause the closing of many beet-sugar factories through the decrease in the yield of beets in the affected areas. It was long believed that an exhaustion of some of the mineral plant foods in the soil occasioned this behavior of the beets, especially since fields in which beets had been grown for many years in succession were most affected. On this account the Germans named the trouble "beat weariness" of the soil—a name still extensively used in Germany, although it is now well known that the trouble is caused by the attacks of this microscopic eelworm.

As already mentioned, the beet nematode is very widely spread in Europe, being found in practically every European country where sugar beets are grown. It is not certain whether this pest is a native of Europe; probably it was carried into Europe on plants imported from the Tropics more than a century ago.

THE BEET NEMATODE IN THE UNITED STATES.

It should be realized that the sugar-beet eelworm already has been introduced into the United States, that it has even become well established in several of the older beet districts in the West, that where it has been established it is locally as destructive as anywhere in Europe, and that as yet practically no steps have been taken to check or eradicate it or to prevent its further introduction and spread. Therefore, to save the beet-sugar industry of the United States from bitter experiences and enormous losses, like those suffered by European beet growers, no time should be lost in putting into operation suitable preventive measures.

In view of the fact that all the forms of this nematode, except the brown cyst, are sensitive to drying, it seems very probable that the pest has largely been introduced in the preservation form, or brown cyst. At harvest, the cut stems of ripe beet seed frequently come in contact with the ground, and particles of soil cling to them. If this soil were infested with brown cysts it seems probable that some of them would find their way into the sacks of beet seed and be carried to any country importing the seed. Even a small number of brown cysts thus distributed every year in any given locality would be sufficient to establish the pest there, especially where successive crops of sugar beets are grown year after year in the same fields. It may also have been introduced in any stage of development in moist soil clinging to the roots of imported plants and potatoes.

To judge from the extent to which the beet eelworm had become established in some of the oldest beet districts of the West in 1907, when it was first recognized there, it must have been introduced a number of years earlier. At first its spread in these localities was rather slow. A survey made in 1912 showed the nematode to be steadily spreading in regions originally infested, that it had been introduced into new areas widely separated from the districts originally found infested, but that there were still many beet districts where it had not been discovered.

EFFECTS OF BEET-NEMATODE ATTACKS.

EFFECT ON THE ROOTS OF BEETS.

The active young beet eelworms are in some way able to find the roots of sugar beets and other plants upon which they feed. Generally they attack fine rootlets about one twenty-fifth of an inch in diameter. With its strong spear (fig. 1, *H*) the larva is able to pierce its way into the tissue of a rootlet until it is entirely embedded. In the rootlets the eelworms feed on the plant juices, thus partly exhausting the plant. In addition, their presence and activities seem to cause an irritation in the rootlets and bring about the destruction of some of the cells and the plugging of the conducting tubes. Finally, the infested rootlets are unable to convey water and mineral solutions from the soil to the beets. The rootlets then die. In an effort to overcome this trouble the beet repeatedly puts forth new rootlets. At length a characteristic dense mass of rootlets is developed. In Europe this condition has earned the names "hunger roots," "bearded roots," "hairy-root," etc. (Fig. 2.) When the plant is badly infested, the beet itself is stunted and looks very much like the root of a celery plant. It is sometimes called "celery-root" on that account. This condition also closely resembles that of beets severely attacked by curly-top and known in this country as "whiskered beets." (Fig. 3.)

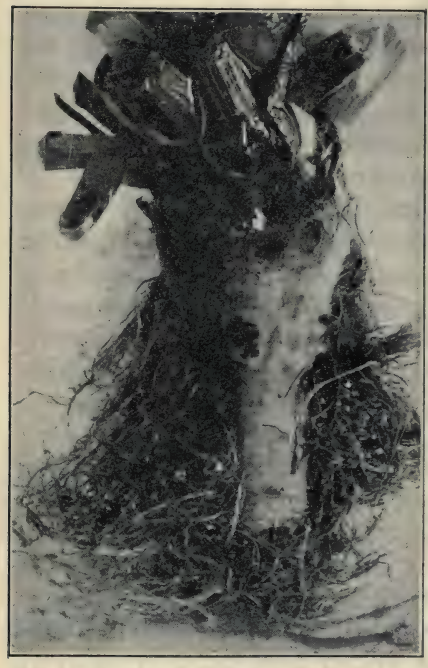

FIG. 2.—A sugar beet infested with beet nematodes. The white bodies of female nematodes can be seen clinging to the rootlets.

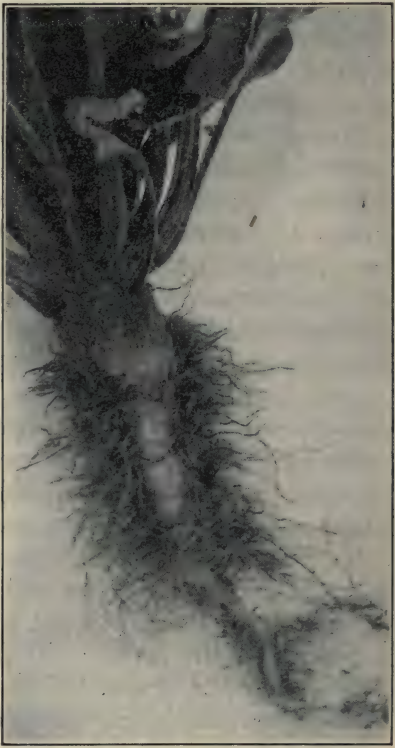

FIG. 3.—A sugar beet affected with curly-top, showing the characteristic dense mass of rootlets.

A close examination of such beet roots will generally reveal the presence of numerous yellowish white beadlike objects clinging to the rootlets. (See fig. 2.) These are the protruding bodies of female nematodes. This form and the brown cyst are the only stages of the beet nematode that are visible to the naked eye. Occasionally small swellings may be found on infested rootlets (fig. 1, *F*). They occur chiefly where young eelworms have been at work only a short time. When many of these exist close together they may somewhat resemble the galls caused by the nearly related root-knot nematode, but they are later absorbed or buried in the continued growth of the rootlets.

Eelworms can not be found on beet rootlets during the last stage of the trouble; that is, where the beets are dead or dying in badly infested fields. On the other hand, they may be found on beets that have made some recovery or shown resistance.

EFFECT ON THE FOLIAGE.

Naturally, such interference with the activities of the rootlets will seriously affect all portions of infested plants; consequently, the leaves show signs of the nematode attacks, although these nematodes never attack any part of the plant above ground.

Toward the end of July or early in August spots may be noted in beet fields where the foliage has become lighter in tint than that of healthy beets; the leaves of the affected plants droop until they lie prone upon the ground, and they do not recover during the night. The outer leaves become yellowish, spotted, and generally discolored; then they wilt and die. The inner leaves fail to reach their normal size, and if the plant is badly infested, they also die. Occasionally the crown of infested beets becomes blackened with rot. Starting at the crown, the rot may penetrate the root, causing it to become brown and limp. This rot is not caused by the eelworm itself, but by bacteria or fungi that are enabled to attack the sick beet. When not severely attacked, the beet may survive until harvest. In such a case new heart leaves are developed, which, however, do not attain the size of healthy beet leaves, are often curled and misshapen, and assume a dark-green color.

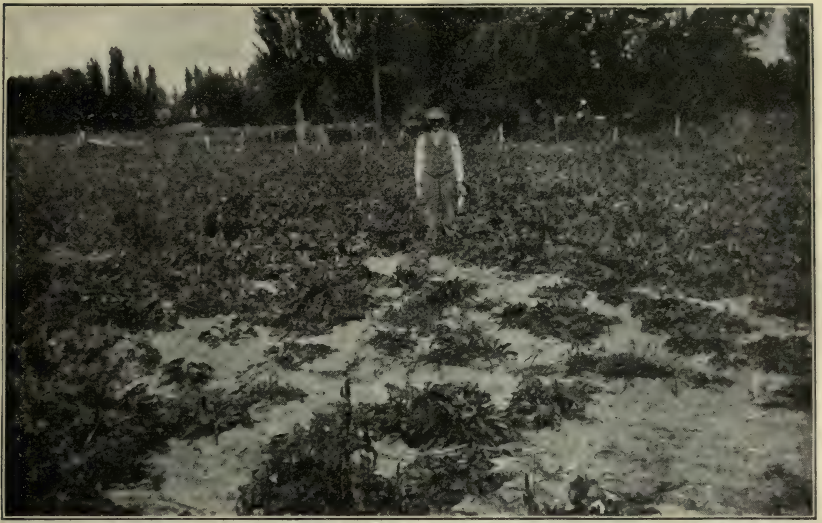

FIG. 4.—A sugar-beet field, showing a sharply defined area where many beets have been destroyed by nematodes infesting the roots. (Photographed by L. P. Byars.)

At first the eelworm may infest only small areas; these are sharply defined by the gaps left by the destruction of the badly infested beets. (Fig. 4.) Often whole fields are infested.

EFFECT ON THE YIELD AND SUGAR CONTENT OF BEETS.

The average weight of foliage of sugar beets infested with beet nematodes may fall as low as one-fifth that of healthy beets; the average root weight suffers correspondingly. A representative experiment showed an average of 14.9 per cent of sugar in healthy beets, 11.35 per cent in beets moderately infested with nematodes, and only 8.4 per cent in badly infested beets. Both leaves and roots of healthy beets are found to contain a much higher percentage of proteids and other nitrogenous compounds, as well as an enormously increased percentage of dry ash, than the corresponding parts of nematode-infested beets. This also shows how seriously the functions of the beet are interfered with.

DIFFERENCES BETWEEN THE BEET NEMATODE AND THE ROOT-KNOT NEMATODE.

The sugar-beet nematode is related to and rather closely resembles the root-knot nematode.[1] To assist in distinguishing them the following differences are pointed out:

THE BEET NEMATODE.	THE ROOT-KNOT NEMATODE.
Produces no galls on beets.	Produces galls on beets (fig. 5).
Body of female remains outside the beet, only the head parts being embedded.	Entire body of female usually buried in root tissue, though portions of hind part of body may occasionally be found outside the roots.
Female usually lemon shaped, dull white, and flaky.	Female pear shaped or flask shaped, glistening, and pearly white. (Fig. 1, *E*, and fig. 6.)
Some eggs deposited outside the body of the female, but most of them develop within the body.	All but last few eggs deposited outside the body of the female.
Spear of larva and adult male longer and stouter than that of the root-knot nematode.	Spear of larva and adult male shorter and weaker than that of the beet nematode.
Possesses a brown-cyst stage.	Has no brown-cyst stage.
Larvæ can not withstand the cold of winter.	Larvæ can withstand the winter.
Can thrive in heavy soils.	Can thrive only in the lighter, sandy soils.
Causes "hairy-root."	Does not cause "hairy-root."
Greatly decreases sugar content of infested beets.	Slightly decreases sugar content of infested beets.

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[1] Scientific name of the root-knot nematode, *Heterodera radicicola.*

CONDITIONS FAVORABLE TO THE BEET NEMATODE.

SOIL.

Cultural conditions in general favor the spread and perpetuation of the beet nematode, but it is sufficiently robust to thrive in almost any kind of soil, light or heavy. In this respect it is unlike the root-knot nematode, which can thrive only in the lighter, sandy soils. Doubtless this is due to the fact that the beet eelworm possesses a much stronger spear than the root-knot nematode.

WEEDS AND OTHER PLANTS.

The sugar-beet eelworm can live on the roots of many different kinds of plants. These include some of the commonest weeds, as well as cultivated plants. Weeds springing up after harvest, along roadsides, and on the margins of fields and irrigation ditches are fine hold-over places for this pest.

TEMPERATURE.

Although the eggs and larvæ are killed by slight frosts, the brown cyst can withstand the rigors of winter and preserve the eggs it contains. Probably some larvæ seek the deeper soil on the approach of winter and others gain entrance to root tissues, where they survive until the following spring. The summer temperature of the soil is highly favorable to the rapid development of this eelworm. All forms of the sugar-beet eelworm except the brown cyst are destroyed by a temperature of 95° F., whereas a temperature of not less than 145° F. is necessary to make certain the destruction of eggs protected within the brown cyst. In many States the cold of winter is severe enough to penetrate sufficiently deep to destroy all except those protected within the brown cysts. In localities having high summer temperatures the nematode is not destroyed by the

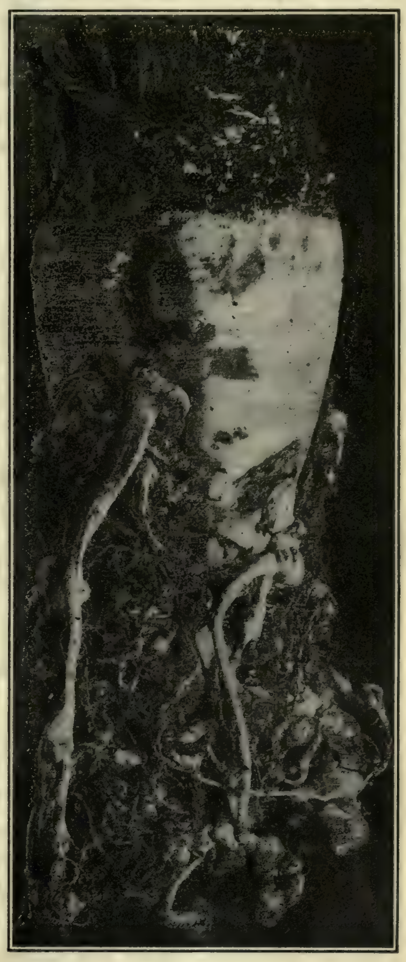

FIG. 5.—A sugar beet affected with root-knot. In certain sections of the Southwest the growing of sugar beets has been prevented by this disease.

heat, because it is protected by the moist soil, which at a depth of a few inches never attains the high temperature of the air.

MOISTURE.

The degree of moisture usually retained in cultivated soils is very favorable to the beet eelworm.

SUCCESSIVE SUSCEPTIBLE CROPS.

The repeated growing of sugar beets and other crops subject to attack by beet eelworms is most favorable to the continuance and increase of the pest.

PROLIFIC CHARACTER.

The pest is very prolific. It may bring forth five to seven generations during a growing season. It has been calculated that if each female brought forth only 100 young, in six generations it would be possible for one pair to produce 31,887,755,100 individuals, or the astounding number of 22,781,000,000,000 if each female produced the entirely possible number of 300 young.[1]

ABSENCE OF ENEMIES.

The sugar-beet eelworm is not known to have any insect or other natural enemy, except, perhaps, some species of nematodes that devour their kind, and it is protected to a large extent from climatic dangers by the soil.

METHODS OF SPREADING THE PEST.

MOVEMENT BY ITS OWN POWER.

The sugar-beet nematode is able to extend its ravages greatly by its own movements. Under favorable conditions the larvæ can travel about 10 feet in one generation. Thus in the five to seven possible generations they may travel from 50 to 75 feet. The distance traveled would depend largely on the proximity of suitable host plants, the character of the soil, and the duration of warm weather. As the weather becomes cooler the movements of the nematode become more and more sluggish.

OTHER MEANS OF TRANSPORTATION.

When they have once been introduced into a beet district, it is an easy matter to spread the eelworms from one field to another; indeed, it is difficult to avoid doing so. Soil infested with nematodes at any stage of development may be carried from one place to another on the hoofs of horses and other live stock, the wheels of wagons and other vehicles and implements, the shoes of persons, and especially the implements used in the fields. Heavy rains and irrigation water are capable of carrying the pest long distances, to infest more land. The soil left in wagons in which infested beets have been carried may be scattered broadcast over land not previously infested. The water in which beets have been washed at the sugar factory and the mud from the factory settling pond, as well as trash thrown from the factory, may be and often are prolific sources of reinfestation and wide distribution. Thus, the pest may be spread in an increasingly rapid manner after being established in a district.

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[1] Calculated by the Austrian investigators Vanha and Stoklasa.

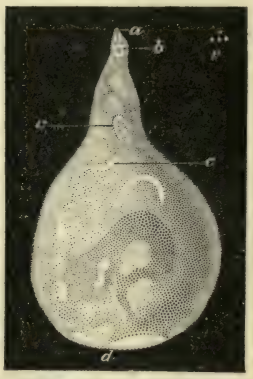

Fig. 6.—A female of the gallworm (*Heterodera radicicola*), magnified 85 diameters: *a*, Mouth; *b*, spherical sucking bulb; *c*, *c*, ovaries, as seen through the body wall; *d*, anus; *e*, small white spots, showing approximately the natural size of these worms. During the egg-laying period they are usually a glistening white and can be readily seen with the unaided eye by carefully breaking open an infested gall. (After N. A. Cobb.)

It was discovered in Europe that one of the most serious methods of spreading the pest was by using as fertilizers waste water from the beet washers and mud from the settling pond. It was found that if the water of the settling pond were made alkaline to the extent of 0.031 per cent with quicklime, all the eelworms contained in such water would be destroyed within 40 days. However, it is doubtful whether such a treatment is practicable. On no account should eelworm-infested factory waste water, slime, or trash be applied to cultivated land; nor should composts mixed with infested soil be applied to clean land until the eelworms have been destroyed by the addition of a considerable percentage of fresh lime.

The beet nematode does not pass through the intestines of sheep alive, but it is not yet known whether this is true of other farm animals. Therefore, it is advisable that all beet tops and other parts of sugar beets and other plants infested with nematodes be fed to sheep alone until it has been definitely determined whether or not the pest in any of its forms can pass through other animals and remain alive.

PLANTS SUBJECT TO ATTACK BY BEET NEMATODES.

The sugar-beet nematode is known to attack numerous kinds of plants. Although some kinds of crops susceptible to the sugar-beet nematode do not show the effects of the attacks of this eelworm, such plants should not form a part of the rotation series on nematode-infested ground, as they would help to increase the number of beet nematodes in the soil.

The plants named in the following list are known to be subject to the attacks of the beet nematode:

Alfalfa.
Allseed.
Barley.
Bean, dwarf pea.
Bean, Lima.
Beets, Garden.
Beets, sugar.
Cabbage.
Cabbage, Chinese.
Cauliflower.
Celery.
Clover, crimson.
Clover, white.
Corn.
Cress.
Dandelion.
Foxtail, green.
Hemp.
Hops.
Kale.
Kohl-rabi.
Lentils.
Lupine, yellow.
Meadow grass, annual.
Meadow oat-grass, tall.
Mustard.
Oats.
Parsnip.
Pea, garden.
Pea, sweet.
Pink.
Potato.
Radish.
Rape.
Rutabaga.
Rye.
Sorghum.
Spinach.
Sunflower.
Timothy.
Turnip.
Vetch.
Wheat.

According to the degree of certainty with which these plants are subject to attack, they may be grouped as follows:

(1) Those especially and regularly subject to attack. These include every kind of beet; also cabbage, cauliflower, Brussels sprouts, rape, white and black mustard, cress, and kohl-rabi.

(2) Those upon which nematodes only occasionally appear. Oats are the chief example.

(3) Plants which are attacked by scattered individuals or by colonies of nematodes. Such are the legumes, the clovers, barley, corn, rye, wheat, Lima bean, and potato.

(4) Most of the common weeds.

PLANTS NOT SUBJECT TO ATTACK.

Although the list of plants not known to be subject to the attacks of the beet nematode is large, doubtless many of these supposedly immune plants will prove to be susceptible. Among those at present found in European countries to be free from or highly resistant to the attacks of this pest are the following:

Field crops.—Buckwheat, chicory, the clovers (except crimson and white), flax, the grasses (except tall meadow oat-grass), horse, bean, pea (Spanish, everlasting, and yellow flowered, but not the garden or field pea), spelt, tobacco.

Truck crops.—Artichoke, asparagus, carrot, chives, cucumber, gooseberry, horseberry, leek, lettuce, onion, oyster plant, parsley, pepper (red and cayenne), pumpkin, raspberry, shallot, strawberry.

Miscellaneous crops.—Almond, anise, apple, caraway, cherry (mahaleb), coriander, dill, hollyhock, marigold, marjoram, mint (curled), poppy, purslane, sage (white and scarlet), savory, thyme, violet (English).

The more important of these crop plants are arranged below in three groups, according to their relative economic importance:

Of importance.—Herd's grass (redtop), Rhode Island bent-grass, orchard grass, tall meadow grass, flax, tobacco, greengage plum (the *domestica* varieties), spelt.

Of less importance.—Onion, red or cayenne pepper, parsley, chicory, asparagus, cucumber, pumpkin, carrot, strawberry, Jerusalem artichoke, lettuce, oyster plant.

Of great or small importance, according to locality.—Indian millet, white sweet clover.

In Europe the potato is found to be but little subject to beet-nematode attack and is therefore generally included in the rotation series. This crop plant might be added to the third group. It has also been reported that in California barley, corn (maize), Lima beans, and wheat are so little susceptible to nematode attack as to be recommended for use in a rotation series.[1]

INEFFECTIVE METHODS OF COMBATING THE NEMATODE.

To save the beet grower of this country from useless efforts, mention will be made of some of the methods that have proved either useless or impracticable on a field scale or are too costly. The seed of some rapidly growing crop, such as rape, which is very attractive to this pest, was sown between the rows of beet seed. This so-called trap crop soon sprouted and attracted the eelworms to its roots. At a proper time the trap crop was plowed up, exposing the roots to sunshine and thus killing the nematodes. This method proved too uncertain.

Various chemicals, such as carbon disulphid, gas water, gas lime, quicklime, and calcium carbid, have been applied locally. Although some of these chemicals were effective on a small scale, all were abandoned because they were either too costly or not applicable under field conditions.

Heavy applications of commercial fertilizers have been tried, but these were never worth the extra cost, nor did they lessen the number of eelworms.

Live steam may be used on very small plats, but it is useless on a large scale.

HOW TO FIGHT THE BEET NEMATODE.

It can not be too strongly impressed on the grower that the beet nematode is a truly formidable pest. As with many other evils, an ounce of prevention is worth a pound of cure. After a field has become infested with beet nematodes it is not easy to get rid of them.

SURVEY OF SUSPECTED FIELDS.

It is first necessary to learn what fields or portions of fields are infested. To do this, a survey of suspected beet fields should be made soon after the hot season has set in; this is probably about the middle of July in most beet districts. At this time the signs of nematode attack—the wilting and yellowing of the leaves—may be seen.

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[1] Rittue, E. C., Assistant in Sugar-Plant Investigations, Bureau of Plant Industry.

A map or plan should be made of each infested field; upon this map all infested areas should be carefully marked, so that the grower may watch the marked spots from year to year.

LOCAL MEASURES.

After the discovery of the pest it is important that no time be lost in checking or destroying it. Local measures may then be sufficient. We will suppose that one of the sharply defined infested areas has been found in a field of beets. The beets remaining in this spot and those for several feet around it should be pulled. As many of their rootlets as possible should also be removed from this place. The pulled beets and roots should next be destroyed by covering them with quicklime, though if they can be carried away without scattering the soil that clings to the roots they may be fed to sheep. A narrow trench, about a foot deep, should be dug around the spot from which the beets have been pulled. Unslaked lime must then be plentifully scattered in the trench, and the area inclosed by the trench must also be heavily spread with lime, which must be thoroughly mixed with the soil by digging the infested area at least a foot deep. This mixing must be repeated frequently during the hot weather, both to bring the lime in contact with the eelworms and to dry them out by exposing more and more of them to the air and sunshine, as well as to destroy weeds. This is the cheapest, most efficacious, and practical method for small areas.

FIELD METHODS.

Rotation with immune crops is the only method of checking this pest known to be effective and practicable when large areas or entire fields have become infested.

Disease and pest control by means of crop rotation is based on the fact that certain diseases and pests can thrive on and cause injury to particular kinds of plants, but not to others. To change the crops in a proper manner will deprive the disease or pest of the kind of plant it can thrive upon, and thus cause that disease or pest to become less severe or to disappear.

In planning a crop rotation for the control of the beet nematode the first consideration should be to make up the rotation series with crops not subject to attack by the beet nematode. However, it is desirable to keep other essentials of a good crop rotation in view at the same time. It should be the endeavor to arrange the rotation so as to leave each field in a better state of cultivation, as well as to keep in check pests and diseases to which each crop of the series may be subject.

While no definite rotation series is offered, because such a rotation must be adapted to each locality, even to each farm and field, certain broad principles should be applied in all profitable crop rotations. They should contain at least one leguminous crop, such as the clovers, beans, or peas. Such a green crop should be plowed under to furnish humus. Fortunately, it is possible to select leguminous crops not subject to attacks of the beet nematode. In this rotation care should be taken to avoid any crop besides beets that is subject to the attacks of these nematodes. This rotation series should be planned to cover not less than four or five years, which period has been found in European countries to be fairly satisfactory.

On account of the brown-cyst or preservation form of the beet nematode it would be safer to extend the rotation period to six years; then even the eggs protected by the brown cyst would all hatch out and succumb during such a period.

During the entire course of the rotation series very thorough culture should be practiced to keep down weeds; otherwise the use of immune crops will be of little avail. Weeds springing up after harvest along roadsides, on the margins of fields, and on the banks of irrigation ditches should be kept down or they will furnish holdover places for the nematodes.

If the land is not badly infested, much benefit would follow a 4-year rotation.

CROPS AVAILABLE FOR ROTATION ON INFESTED LAND.

To assist the beet grower to plan a rotation series with crops immune to the beet nematode, the following schedule is offered for various parts of the United States where sugar beets are grown; since the beet zone of this country includes many States and different climatic conditions, several groups of States are dealt with.

(1) California and Arizona.
(2) Oregon and Washington.
(3) Utah, Montana, Nevada, Colorado, Kansas, and South Dakota.
(4) Nebraska, Wisconsin, Indiana, Michigan, Ohio, New York, and West Virginia.

The following nonsusceptible crops are suitable for these groups:

Group 1.—Cowpeas, soy beans, sweet clover, rye, the millets, tomatoes, asparagus, lettuce, cantaloupes, strawberries, barley,[1] corn,[1] Lima beans,[1] wheat.[1]

Group 2.—Cowpeas, soy beans, sweet clover, rye, the millets, truck crops (such as lettuce and asparagus, but not celery), barley,[1] wheat.[1]

Group 3.—In addition to the crops mentioned in group 2, cantaloupes, cucumbers, and potatoes.[1]

Group 4.—Clover, cowpeas, sweet clover, soy beans, rye, the millets, tobacco, flax, peppermint, cucumbers, strawberries, melons, lettuce, asparagus, some other truck crops, the grasses with the exception of tall oat-grass, barley,[1] corn,[1] Lima beans,[1] potatoes, and wheat.[1]

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[1] Occasionally slightly infested with beet nematodes, but may be used in a rotation series.

PREVENTING THE FURTHER INTRODUCTION OF THE BEET NEMATODE.

Unfortunately, the means by which the beet nematode has been and perhaps still is being introduced into the United States have not been definitely established. This question is being studied by the United States Department of Agriculture.

It is possible that living nematodes in every stage of development have been brought in from European countries in the moist soil adhering to the roots of nursery stock and potatoes. The pest could be introduced in the brown-cyst stage among imported beet seeds, though it has not yet been proved that they are so introduced. The other stages of the beet nematode could not exist for any considerable time among dry beet seeds, although other destructive species of eelworms can and do come into this country alive among beet seeds and in the small clods of soil generally found in sacks of imported beet seed.

Should it be found that the pest is introduced in the soil about the roots of imported plants, its continued introduction by this means could be prevented only by requiring the fumigation of all such plants by the new vacuum process or by forbidding the importation of plants whose roots carry soil.

Should it be ascertained that the brown-cyst stage of the beet nematode is brought in with imported beet seeds, it will be practicable to destroy it without injury to the seeds. It has already been stated that the entire contents of the preservation form can be destroyed by exposure to a dry heat of 145° F. for as short a time as 1 minute. Experiments have shown that exposures of 5 to 10 minutes to dry heat as great as 149° to 158° F. not only fail to injure beet seed, but appreciably improve its germinability. Thus, a method is available to destroy beet eelworms imported with beet seed, should it be found that the pest is so introduced.

BREEDING OR SELECTING RESISTANT BEETS.

Experience with other plants indicates that it might be possible through breeding and selection to develop strains of sugar beets resistant or distasteful to the beet nematode. However, this is not a matter than can well be handled by the beet grower; it is a problem that could best be taken up by the United States Department of Agriculture, the State agricultural experiment stations in the beet zone, and other agencies interested in producing beet seed.

SUMMARY.

The sugar-beet nematode,[1] a species of eelworm closely related to the root-knot nematode,[2] has been for many years a serious pest of the sugar beet in European countries. The losses occasioned by this microscopic eelworm were at one time so great as to cause the closing of numerous European beet-sugar factories.

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[1] *Heterodera schachtii.*

[2] *Heterodera radicicola.*

This nematode attacks the rootlets of beets and numerous other cultivated plants, as well as most of our common weeds. Its attacks on the rootlets of beets cause a clogging of their conducting vessels, and finally the destruction of the rootlets. In its efforts to recover, the beet repeatedly produces new rootlets, which at length form a dense mass characteristic of the trouble. Owing to the root injury the whole plant suffers; the leaves wilt without recovering during the night, turn yellow, and die. In severe cases the whole plant is destroyed, thus leaving sharply defined bare or partly denuded spots in the beet fields. Sometimes whole fields of sugar beets are almost entirely destroyed. The attacks of the pest cause a marked decrease in the sugar content of infested sugar beets.

This pest already has been introduced into the United States and has become established in several sugar-beet districts of the West, where its effects have been as injurious as in European countries. It may have been introduced with nursery stock, potatoes, or with beet seed.

After many years of experimentation it has been found that the only practicable method of controlling the pest on a large scale is by the rotation of crops not attacked by this nematode. A rotation of four or five years, including beets or other susceptible crops only once in the series, has been found in European countries to keep the pest fairly well under control, but owing to the fact that eggs may be preserved for a number of years in brown cysts, it would be safer to extend the rotation to six years.

Where only small areas of land are infested with beet nematodes it is possible to get rid of them by the liberal application of unslaked lime, which should be thoroughly mixed with the infested soil to a depth of at least a foot, the mixture of soil and lime being turned over frequently during the summer. These infested areas generally show themselves about the middle of July through the wilting and yellowing of the leaves. The wilted leaves do not recover during the night.

All forms of the beet nematode, including the resistant preservation form, the brown cyst, can be destroyed by a short exposure to a dry temperature of 145° F. Beet seed exposed to a dry temperature of 149° to 158° F. for 10 minutes is not injured by the treatment; on the other hand, its germinability is improved. Should it be established that the beet nematode is introduced with beet seed, this method will be available for the destruction of the pest before the seed is distributed and sown.

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CORN GROWING UNDER DROUGHTY CONDITIONS

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Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

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CORN GROWING UNDER DROUGHTY CONDITIONS.

CONTENTS.

	Page.		Page.
Introduction	3	Methods of planting	14
Why corn growing is attempted in semiarid regions	4	Cultivation	16
Corn not naturally adapted to semiarid regions	5	Corn growing under irrigation	18
Some essentials of corn production	7	Animal and insect enemies	20
Getting moisture into the soil	8	Principles governing the choice of varieties	21
Preparing land for planting	10	Need of good sources of seed corn	22
Time of planting	12	Pasturing corn	23
		Conclusions	24

INTRODUCTION.

For 50 years new settlers from the East have attempted to grow corn in the semiarid West. The seed used and the methods employed were often those with which the settlers had had experience in the East. These were not adapted to western conditions, and many failures resulted. In the settling, moving out, and resettling which has taken place, these mistakes often have been repeated. Here and there pioneers have remained, and as a result of their experience have adopted varieties of corn and methods of corn culture which are better adapted to the conditions. (Fig. 1.) Unfortunately, few records are left of the unsuccessful attempts, and the reasons for the better successes of the pioneers are little known except by the pioneers themselves.

It is the purpose of this bulletin to show in a general way some of the causes of these failures and how failures may be made less frequent or less intense. Particular varieties of corn and particular methods of cultivation are not applicable to the whole of any large area. Nevertheless, there are certain fundamental requirements of moisture, heat, and fertility which everywhere govern corn yields. A change in the supply of one may make a change in another advisable. Thus, the moisture requirement varies with the amount of heat available. In short, the secret of successful corn culture is to maintain a proper balance of moisture, heat, and fertility.

The region to which the principles and methods herein discussed are especially applicable can not be designated by average yearly rainfall or by definite boundaries, because the time of year when rains

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NOTE.—This bulletin is especially applicable in dry-land regions; but corn yields are so dependent upon the relative amounts of soil moisture and heat that the principles here given apply wherever corn is raised.

occur, the nature of the soil, the rate of evaporation, and the temperature are all factors of great importance in determining the amount of moisture which can be made available to a corn crop.

WHY CORN GROWING IS ATTEMPTED IN SEMIARID REGIONS.

Farmers from the East, accustomed to obtaining good corn yields wherever the soil is fertile, have not readily understood that corn may not be the best crop for rich prairie soils. They are apt to think that the other man's failures were due to poor methods. They therefore do not adopt other varieties and apparently poorer methods until they have given eastern varieties and methods a trial under the new conditions. Thus, in some cases experience with corn under corn-belt conditions has proved a disadvantage rather than an advantage to new settlers in semiarid regions.

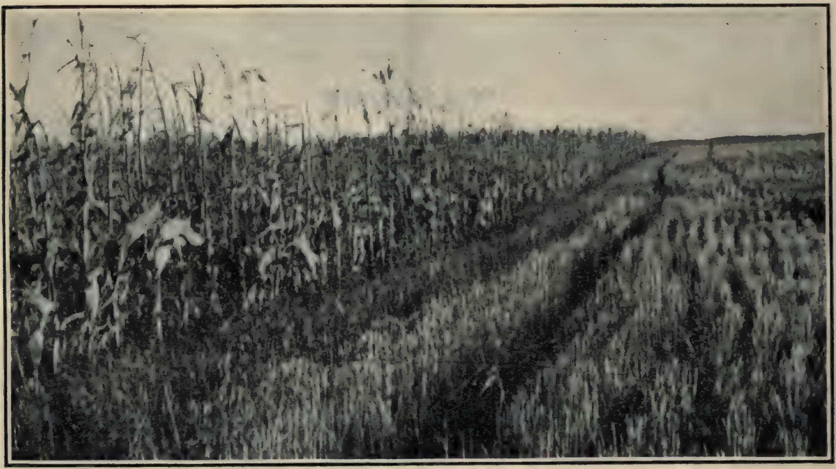

FIG. 1.—A characteristic view in the northern portion of the Great Plains, where vast areas are occupied by corn one year and by wheat or oats the next. In regions especially adapted to small grains a cultivated crop is needed in crop rotation. Corn frequently supplies this need.

It is coming to be believed that diversified farming, including the raising of live stock, is essential to the establishment and development of a permanent agriculture in the semiarid sections of the West. This requires that a diversity of crops be grown and that the crops be such as furnish food for animals.

Transportation is often so difficult or costly that new settlers must grow the crops which supply food for themselves and their animals. Corn is therefore often grown under conditions less favorable to it than to other crops. To produce rough feed, corn is sometimes grown to advantage even under conditions so severe that it yields no grain. Most semiarid lands are comparatively cheap and easily prepared for corn.

The continued growing of small grain on the same land usually results in decreased yields and is recognized as poor practice. The need of a cultivated crop in rotations causes corn to be grown extensively in semiarid regions. Knowledge of corn and how to grow it gained in other sections naturally turns attention to it, and it is adopted in rotations. In some cases the soil improvement due to the cultivation of corn justifies the growing of this crop even when the crop harvested does not pay the entire cost of its production. In semiarid regions corn, as well as small grains, produces better after corn than after small grains. In sections having a long growing season the grain sorghums are likely to outyield corn and are well suited to extensive culture in rotation with small grains.

No methods have been found that overcome the effects of the most severe droughts. The growing of crops in droughty sections is always attended with more or less risk. The experienced farmer recognizes this and adopts those practices which enable him best to tide over unfavorable years. In those sections where the time of occurrence of drought or rains is uncertain, the growing of crops which mature at different seasons is a wise practice. In some seasons early rains and late droughts make good small-grain crops, while the corn crop fails. When the conditions of moisture and drought are reversed, small grain may fail and corn make a crop.

Attempts to grow corn on the natural rainfall of semiarid regions and secure large profits by marketing the grain will doubtless, as in the past, be attended with more failures than successes. Considering, however, the value of both grain and stover as feed, the importance of corn in rotations, the need of growing different crops to reduce the chances of an all-round failure, and the better results following the use of adapted varieties and suitable methods, corn has come to be recognized as an important crop for semiarid regions.

CORN NOT NATURALLY ADAPTED TO SEMIARID REGIONS.

Corn possesses characters which appear to make it adapted to droughty conditions. On the other hand it has characters which limit its possibilities as a crop for semiarid regions.

Corn is deep rooted and can, if necessary, draw water from depths of 5 or 6 feet. In hot, dry weather the rolling of the blades reduces the loss of water. Figure 2 shows a field of corn suffering from lack of moisture. In producing a given weight of feed or dry matter, corn uses less water than certain other crops, such as oats, clover, or alfalfa.

The characters which make corn less adapted to semiarid regions than some other crops are its heat requirements and its peculiar flowering habits. Corn makes its entire growth during the season of highest temperature. It is naturally a tropical or subtropical plant and makes its best growth during hot weather, when the thermometer registers 80° to 100° F. It can not grow in early spring or late fall, and growth is retarded during the summer months by cold nights or cool weather. It requires its greatest supply of moisture during the summer weeks, when droughts are most likely to occur and when rains are less effective on account of losses from evaporation. In other words, the heat requirement of corn prevents growth at times when the moisture conditions are likely to be most favorable, while lack of moisture frequently retards growth when the heat conditions are most favorable.

Unlike some perfect-flowered plants, such as alfalfa, which seed abundantly under dry conditions, the setting of seed or the filling of the ears is seriously interfered with by summer drought. Corn has two kinds of flowers, situated some distance apart on the plant. The tassel or pollen-bearing flowers at the top of the stalk are exposed to hot winds and sunshine. The pollen is further exposed in falling to the middle of the stalk to fertilize the silks of the seed-forming flowers. Droughty conditions often hasten the shedding of pollen but delay the appearance of silks. Thus, it sometimes happens that the pollen is mostly wasted before the silk appears. If fertilization is prevented in this way, no amount of later rain can cause kernels to form or make a good grain yield. The corn crop is thus sometimes injured by hot winds that do less damage to such crops as alfalfa and the grain sorghums.

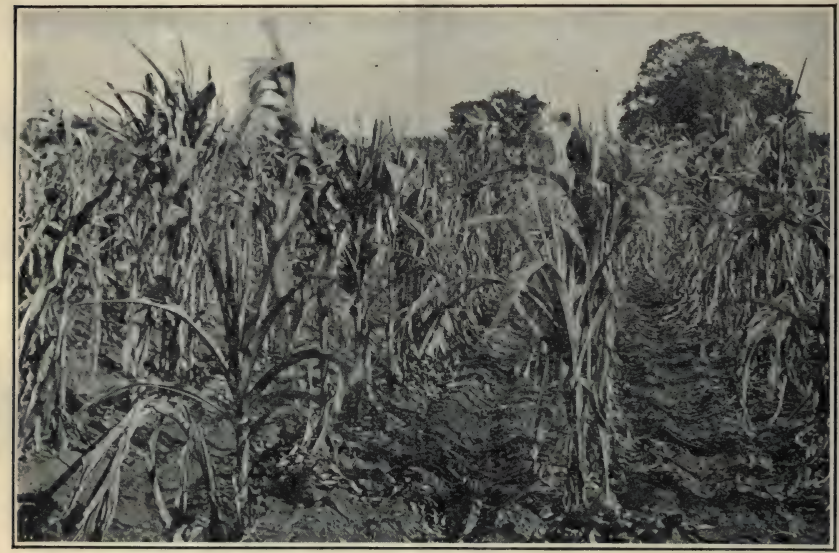

FIG. 2.—A Texas cornfield in August. This crop was a failure because the soil moisture became exhausted just when the plants should have begun to form ears.

SOME ESSENTIALS OF CORN PRODUCTION.

In the United States each year a billion five hundred million dollars' worth of corn is produced. Of what is this corn made? Mostly of water and air. With liquid taken from the soil by the roots and carbon taken from the air by the blades, the plant makes corn by the aid of the sun.

The chief essentials of corn production are water, heat, soil fertility, and seed. No one of these can be said to be more important than another. Where all are abundant except one (as water, for example), this one becomes the "limiting factor," and methods of supplying it become the important means of increasing the yield.

In our semiarid regions the soils for the most part are fertile, and the limiting factor is either water or heat. Raising corn may be likened to raising steam in an engine. Too much water lowers the temperature, whereas too little water is dangerous. Growth can take place only while there is a proper balance between heat and water. The two must be in the soil at the same time. Water falling as snow or rain before heat is present should be stored in the soil. The boiler should be filled before the fire is started.

In northern sections and at high altitudes the lack of heat limits corn yields, while in southern sections it is the lack of moisture. Abundant soil moisture reduces soil heat—desirable in the South, but undesirable in the North. Far north a soil with a wet surface is usually a cold soil. Here the conservation of heat is more important than the conservation of moisture. Evaporation keeps the soil cool. Soil moisture rises to the surface to replace that which evaporates. Cultivation checks the rise of soil moisture to the surface, enabling the surface to dry more rapidly. The dry surface then becomes warm by taking in heat, which otherwise would have been wasted in evaporating water from below. Corn cultivated late in the afternoon may be frosted that night, while adjoining uncultivated rows escape the frost. The more rapid evaporation caused by recent cultivation first cools the surface, but as soon as the surface dries, the soil becomes warm quicker and the crop grows more rapidly than it would have done without the cultivation.

A glance at the corn yields of Kansas, Nebraska, South Dakota, and North Dakota for the hot, dry summer of 1913 and for the cool, wet summer of 1915 shows the effects of unbalanced amounts of heat and moisture. (Table I.)

In 1913 the yields increased from Kansas northward. In 1915 the yields decreased from Kansas northward. Moisture was the limiting factor in 1913 and heat the limiting factor in 1915. North Dakota profited by the excessive heat of 1913 and Kansas by the excessive rain of 1915.

TABLE I.—*Yield of corn per acre in Kansas, Nebraska, South Dakota, and North Dakota, 1913 and 1915.*

Season.	Kansas.	Nebraska.	South Dakota.	North Dakota.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*
1913 (hot, dry summer)	3	15	26	29
1915 (cool, wet summer)	31	30	29	14

In northern localities, where lack of heat is a factor limiting corn yields, summer fallowing and moisture conservation tend to keep the soil cold and seldom give increased yields of corn. In southern localities, where lack of moisture is the limiting factor, summer fallowing and practices which increase soil moisture give increased yields of corn.

In the southern part of the Great Plains, lack of moisture is the chief limiting factor. Ignoring special instances and speaking generally, every operation should be conducted in such manner and at such time as to enable the soil to take in and retain water. But just how and when is this to be done? Should the land be plowed deep or shallow, in the fall or in the spring? On what date should corn be planted, and how many times should it be cultivated?

These questions can not be answered correctly by rule or by averages. Each field of corn presents a combination of conditions which demand consideration in answering these questions. Time-of-planting tests conducted yearly for 100 years at a particular station might show that the highest average yield had been obtained from corn planted on May 10, and the next spring might be so unusually warm and forward as to warrant planting in April.

GETTING MOISTURE INTO THE SOIL.

Everything corn gets from the soil is in liquid form. The crop can not grow unless the soil contains moisture to spare. Plants, even weeds, can not take over every bit of the moisture from the soil, no matter how much they may need it. It has been estimated that if it were possible to control the soil moisture so that none might escape except through the plants, a rainfall of 10 inches would be sufficient to produce a 50-bushel yield of corn. The soil moisture supply can not, of course, be so completely controlled under field conditions. Where corn growing is attempted under dry-land conditions the annual rainfall is more than 10 inches and the point of most importance is to get as much of it as possible into the soil. Moisture losses from run-off, evaporation, and seepage are always considerable and under some conditions exceed the amount used by the crop. The available soil moisture can be increased by assisting snow and rain to enter the soil and by preventing the escape of moisture except through the growing crop.

The first and most important step in dry-land corn culture is getting moisture into the soil. All cultural operations should be planned so as to have the soil surface in the best condition to take in water and prevent run-off during the period when rains are most likely to occur.

The ease with which soils take in, retain, or lose moisture depends mostly on their texture, physical condition, and surface slope. It is to the extent that cultivation can modify these factors that more water can be made available to the growing crop.

There are loose, open soils through which water pours as through a sieve, and there are tight, gumbo soils, which swell when the surface is moistened and become practically waterproof. Our semiarid regions contain types of soil between these two extremes, which, when an open, rough surface is maintained, can be made to take in nearly all the snow and rain that falls upon them.

Sandy soils take in water more readily than heavier soils; hence, less precaution is necessary to prevent run-off. The surface dries more quickly, thereby more promptly checking loss by evaporation. In sandy and gravelly soils the greatest loss may be from seepage to depths beyond the plant roots. Manure and decaying vegetable matter check seepage and improve soils of this character. As corn roots penetrate 3 to even 6 feet deep, larger yields of corn are frequently raised on sandy soils in semiarid regions than on surrounding hard soils.

The heavy, hard, or close-textured soils require the most cultivation to keep them in proper condition so as to prevent moisture loss from run-off and evaporation. Unless the surface is kept broken or somewhat rough, but little water will be absorbed during hard rains and a greater loss will occur from evaporation. To maintain the surface soil in proper condition, cultivation is necessary soon after heavy rains. If cultivation is too frequent, however, so that the surface becomes too fine, moisture can not penetrate readily and blowing of the soil is likely to occur.

It is of great importance that moisture be made to penetrate several feet below the surface. In most soils this penetration is slow, and during hot, dry weather surface evaporation is great. Surface moisture can not penetrate a frozen soil. Summer and fall precipitation has time to penetrate several feet deep and be in a position to support a growing crop the next summer. While it is seldom advisable to waste a whole summer in storing moisture for a corn crop the next year, it is advisable to begin storing soil moisture as soon as the preceding crop will permit. (Figs. 3 and 4.) The ideal seed bed for a good corn crop in semiarid regions is one with a loose, coarse surface and a subsoil well filled with moisture to a depth of several feet.

PREPARING LAND FOR PLANTING.

As lack of moisture, more than anything else, limits corn yields in droughty regions, the first question regulating each operation should be, "What will be its effect upon the soil moisture supply?"

Summer fallow, or the practice of clean cultivation without cropping during an entire summer, in order to make two years' moisture supply available for one crop, frequently results in the production of larger yields of corn, but the practice has not proved practicable. The cost of summer tillage is usually greater than the gain derived from the increased yield. It is seldom possible by this method to store enough moisture in the soil to supply the crop adequately if rains do not occur while the corn is growing. The losses from seepage and evaporation are considerable, and the young corn plants can not be prevented from exhausting the moisture supply before the ear-forming period, when they need the greatest quantity.

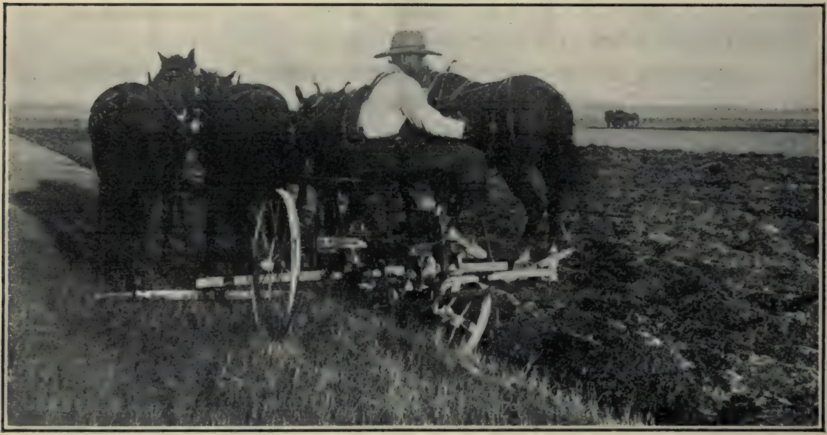

FIG. 3.—Breaking virgin land in South Dakota. A most important task in growing corn with scant rainfall is to get the water a foot or two below the soil surface. An open, rough surface during the fall, winter, and early spring tends to hold snow and rain.

As soon as the preceding crop will permit, it is advisable to begin some preparation of the land that will prevent the loss of moisture and put the surface in condition to take in moisture. Cultivation after the removal of the preceding crop is profitable if it stops or prevents a growth of weeds. But if the growing season is past, dead weeds may catch more snow than would be caught by a cultivated surface.

Fall disking, or listing, is usually beneficial in putting the land in better condition to prevent the soil from blowing, to hold the snow, and to prevent run-off. (See fig. 5.) The penetration of moisture is slow, and when rains occur evaporation is rapid from hard soil surfaces, such as usually follow the growing of small grain. The chances of storing moisture are increased by loosening such compact surfaces as early as possible. Whether plowing is necessary, however, depends very much upon the type of soil. Most heavy clay soils are best put in proper condition by plowing. Sandy or light loam soils should not be plowed in the fall and left bare during the winter in regions where soil blowing is likely to occur. If, however, it becomes advisable to plow such soils in the fall, blowing of the plowed area may be checked by top-dressing with barnyard manure. Young corn plants injured by blowing sand on fall-plowed sandy land not top-dressed are shown in figure 6. Deep plowing should always be done in the fall or very early in the spring, to allow more moisture to penetrate and the soil to settle before planting time.

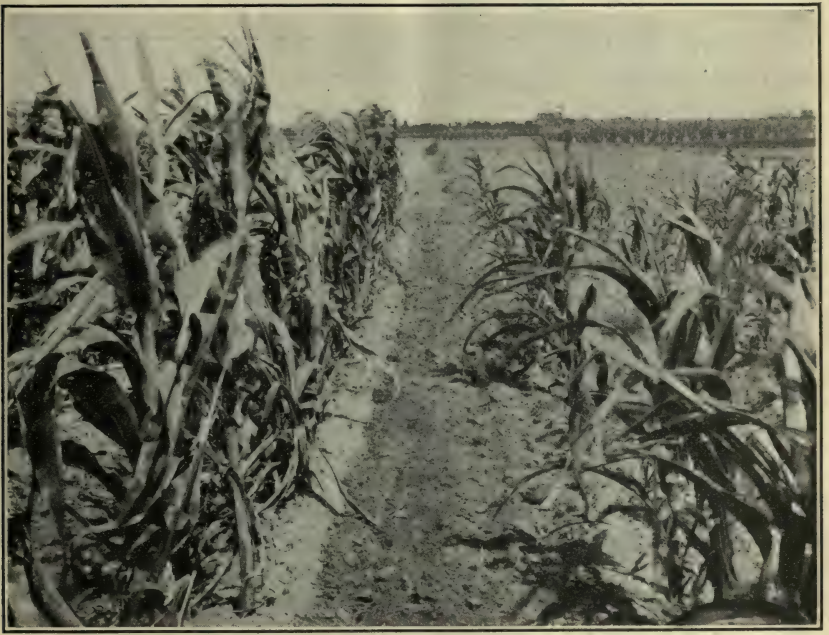

FIG. 4.—Two plats of corn at Amarillo, Tex., listed at the same time, in the same manner, and with the same lot of seed. The fall and spring early disking of the left-hand plat enabled it to take in and hold more moisture and produce better than the right-hand plat, which was not disked.

On sloping land the plowing, listing, planting, and cultivating should follow on a level along the slopes or around the hills. This greatly decreases the run-off from melting snows and heavy rains and increases the amount of water taken in by the soil. The moisture saved makes this a profitable practice, and very often the prevention of run-off is necessary to avoid erosion, with the loss of the richest portions of the soil. (Fig. 7.) Profitable farming can not long continue unless soil washing is prevented. If a little is tolerated it rapidly grows worse and soon makes necessary contour farming, terracing, and the use of commercial fertilizers, when corn raising becomes unprofitable.

Alfalfa land to be prepared for corn should be fallowed one year or plowed early the previous summer. On account of its deep-rooting habit and the nitrogen it adds to the soil, alfalfa is an excellent preparatory crop for corn. Its roots dry out the soil to great depths, however, and unless the land is prepared a sufficient time in advance to allow moisture to be accumulated in the soil the chances of a failure of the corn crop are great.

Growing plants draw large quantities of water from the soil and subsoil. All growth of weeds and volunteer grain on land to be planted to corn should be prevented. Stirring the soil immediately before planting is usually profitable and often saves much labor in keeping the crop free from weeds.

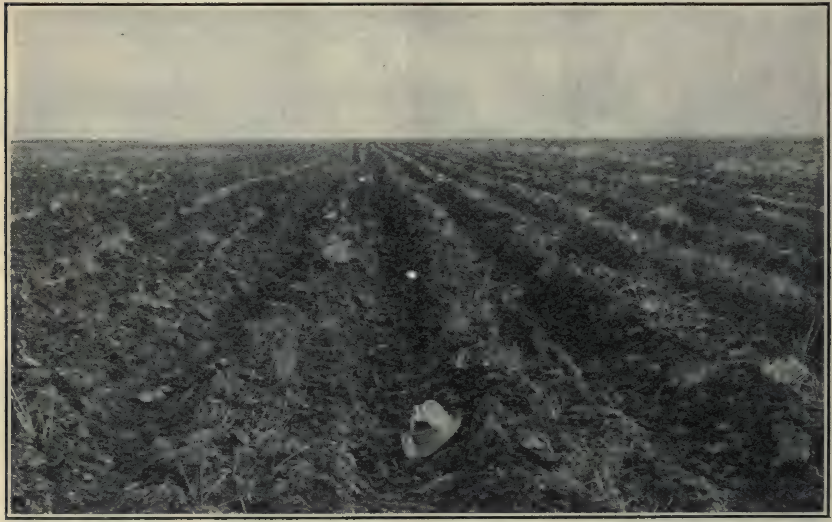

FIG. 5.—A field in western Kansas, showing fall-listed wheat stubble. The lister furrows prevent the drifting of snow and aid in getting the fall, winter, and spring precipitation into the soil.

Deep plowing and subsoiling should be done in the fall rather than at corn-planting time. Soil put in the right condition to take in moisture to a considerable depth is also open to the air and dries out rapidly. If necessary to plow in the spring for corn, the plowing should be done early and should not be deep, and the ground should be packed immediately. Plowing under several inches of snow is an effective and sometimes a practicable way of getting moisture into the ground.

TIME OF PLANTING.

Corn will not grow during as cold weather as wheat or oats. Corn-planting time is therefore a little later than the best time for sowing spring wheat or spring oats. However, when seed of perfect vitality is used it is remarkable how early in the spring corn can be planted and result in good stands and good yields. Seed of perfect vitality will often remain in cold or dry soils for several weeks and afterwards germinate and yield well. Irregular stands (fig. 8) are sometimes attributed to poor seed, when dry, poorly prepared spots are the cause. Fields are sometimes seen in which the seed germinated promptly in moist spots but did not germinate in dry spots until rains came.

Where the seasons are long and moisture plentiful, it is customary to wait until the soil is warm before planting. In semiarid regions, however, corn should be planted early. With the soil in proper condition it is generally advisable in semiarid regions, south as well as north, to plant corn before danger from frost is entirely past. Corn planted very early usually makes a slow, tough growth and a month after planting may be smaller and look less promising than that planted later. The early-planted corn ripens first, however, and usually produces the larger or the better crop. Because of its slow, tough growth, corn planted very early is not so susceptible to frost and drought as corn planted later and growing more rapidly. In a series of years the gain in mature corn secured from early planting will more than make up for any injury from spring frosts. Excellent corn crops have been produced from plantings frozen off or frozen back when the plants were from a few inches to a foot or more tall. Corn is not often entirely killed by spring frosts, and if some should be injured the loss is much less serious than that from summer drought or from fall frost.

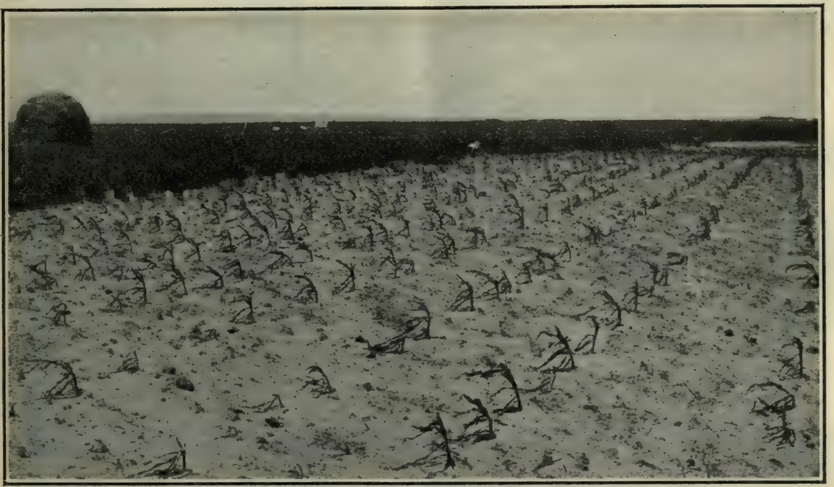

Fig. 6.—A cornfield injured by blowing sand. In some localities corn plants while young need protection. Long, narrow cornfields alternating with alfalfa or other sand-binding crops afford some protection.

Early-planted corn derives more benefit from the spring moisture supply, becomes well rooted before summer droughts begin, and may even mature before these droughts become severe.

Where the growing season is very long and warm, plantings made at about 30-day intervals increase the chances of hitting the season right and raising some good corn.

METHODS OF PLANTING.

Listing, or planting in furrows, is the most common and best method of planting corn in a large part of the semiarid area. It is not only economical, as it permits large acreages to be handled at the least cost, but it also places the plants to the best advantage to withstand drought. As the furrows are closed by cultivation, the plant roots are placed well below the surface. A deep soil mulch can be maintained without injury to the roots. The plants are more securely braced to withstand winds than when surface planted.

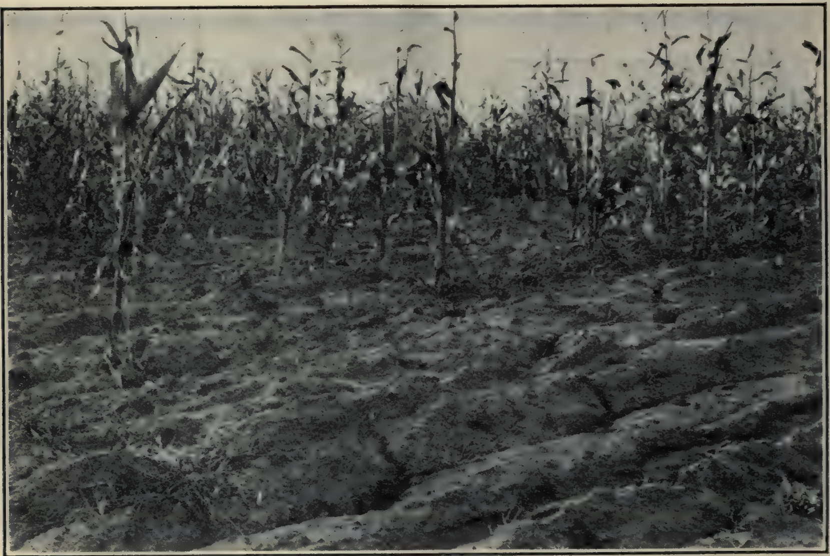

FIG. 7.—A western Kansas cornfield, showing erosion of the soil. Soil washing reduces the moisture supply, the soil fertility, the yields, and the value of the farm.

In some semiarid sections early summer conditions are favorable for rapid growth. The plants make a tender, rapid growth and become larger than the later moisture supply will support. Listing retards this rapid early growth and is often a decided advantage on this account.

Where the seasons are very short, surface planting is better than listing, as the retarding of early growth leaves the plants insufficient time to reach maturity. Where surface planting is practiced on fairly level land it is usually advisable to plant in checks to permit cross cultivation. Cross cultivation makes weed and grass control easier. It also assists cultivation, drying and warming a larger part of the soil surface.

A thin stand of plants is an essential feature of successful corn growing in regions of limited moisture supply. When planting is done with a lister in rows 3 to 3½ feet apart, the plants should be one in a place and from 18 to 36 inches apart, depending upon the rainfall and the fertility and water-holding capacity of the soil. In surface-planted corn with the hills 3½ feet apart each way, the stand should not be thicker than two plants per hill. Even with the best of seed more kernels should be planted than the number of plants desired. Some young plants, mostly the weaker ones, will perish.

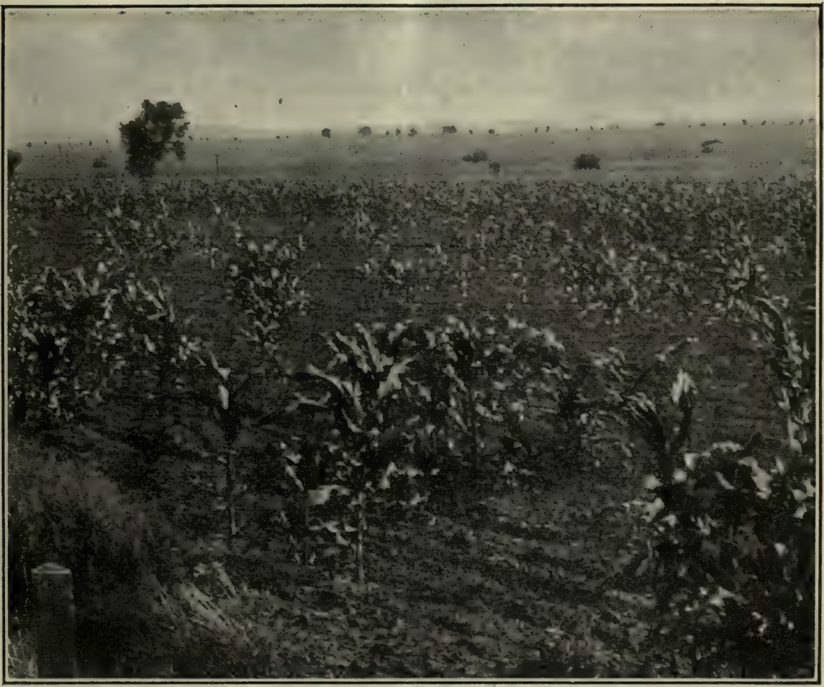

FIG. 8.—A western Nebraska cornfield showing an uneven stand. Irregular stands of plants sometimes result from dry or poorly prepared spots in the field. Note that some plants are much taller than others, indicating a better supply of moisture and earlier germination of the seed.

The usual distance between corn rows is about 3½ feet, which is a convenient distance for cultivating. With the rows at this distance the roots meet between the rows and occupy all of the upper soil before the corn comes into tassel.

In certain droughty sections, where the seasons are comparatively long, increasing the width of row to 7 feet (fig. 9) and doubling the stand in the row has been found to be an advantage. On account of being close together within the rows the young plants compete for the near-by moisture and are prevented from making too rapid and too tender a growth. The roots do not meet between the rows until the plants have about reached their full growth, and the moisture in the soil between the wide rows benefits the plants at the time they are forming ears. Where the summers are long other crops or another crop of corn can be planted later in the season between the 7-foot rows if the seasonal rainfall proves sufficient.

The success of the crop depends upon having the corn reach the ear-forming period when moisture and heat are available at the same time. The chances are increased by making a very early and a late planting of an early-maturing variety. Using seed of an early-maturing variety in one planter box and seed of a late-maturing variety in the other box increases the chances of having some plants reach the ear-forming period when moisture and heat are available at the same time.

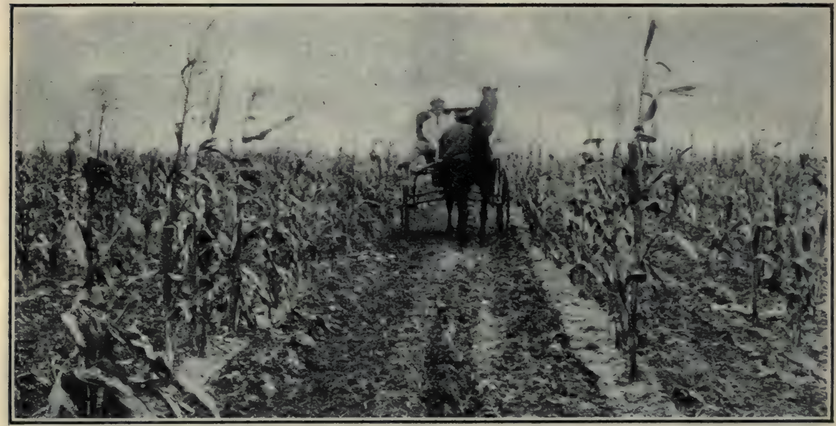

FIG. 9.—A western Kansas cornfield, showing rows 7 feet apart. Wide spaces between rows retain a part of the soil moisture for the critical or ear-forming period. Cultivation and the drilling of wheat, peas, or beans in the corn are made easier, as well as the harvesting of the corn.

Corn should not be covered with more than 1½ or 2 inches of soil except when the surface is dry and it is necessary to plant deeper to reach moist soil. In cold, heavy soils 1 inch is sufficient.

CULTIVATION.

In droughty regions corn cultivation is more essential and requires more good judgment than in most other sections.

The primary object of cultivation is to prevent loss of moisture. Moisture losses are caused by run-off, evaporation, and, most of all, weed growth. The one most important object of corn cultivation is the keeping out of weeds. In this it is true that prevention is better than cure. Cultivation should not be delayed until the weeds are large enough to cause the field to look weedy. It takes but little stirring of the soil to kill weeds immediately after they germinate and before they have used much soil moisture, but to destroy weeds that are well rooted the soil must be worked deeply and thoroughly. This requires much labor and can not be accomplished without breaking and destroying many corn roots. In many sections, or in seasons when the seed germinates slowly, it is advisable to harrow once or twice or to cultivate after planting before the corn comes up.

Limited moisture makes thin stands necessary, and it is poor management to allow grass and weeds to rob the corn of this moisture. (Fig. 10.)

If cornland has been properly prepared deep cultivation is not advisable and often injures the crop. Deep cultivation should never be done close to the plants after they are a foot tall, as much harm would be done by breaking the corn roots.

Aside from destroying weeds, timely cultivation is beneficial in preventing the loss of moisture by evaporation and also in hastening the warming of the soil. The loss of soil moisture by evaporation continues much longer from a compact, damp surface than from a loose, dry surface, and the evaporation tends to keep the soil cold.

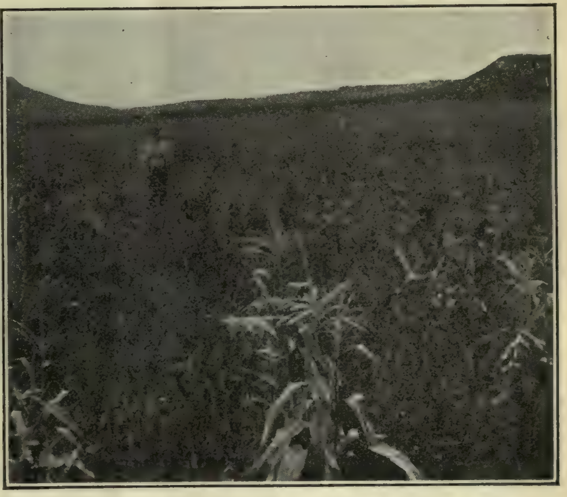

FIG. 10.—A cornfield in New Mexico, showing poor cultivation. Scant precipitation makes thin stands necessary, but a thick stand of grass and weeds is worse than a thick stand of corn.

In northern localities and at high altitudes the conservation of heat is frequently as important as the conservation of moisture. Luckily, both heat and moisture may be conserved by good, timely cultivation. Heat is wasted in evaporating or wasting soil moisture. Making the surface loose and dry saves both soil heat and soil moisture.

Cultivating after heavy rains is a good practice. To be most effective the cultivating should be done as soon as the surface is dry enough to work well. If the soil is allowed to dry until it breaks up cloddy, much moisture will be lost, a good mulch can not be obtained, and harm is more likely to be done to the corn roots. As long as rapid evaporation is taking place, the surface will remain cold and the growth of the corn will be slow. In order to cover large areas quickly, cultivators which work two or more rows are a great advantage.

Figures 11 and 12 show the first and second cultivations of listed corn with 2-row cultivators.

The number of cultivations necessary and the best time for them depend upon weather and soil conditions. Weeds should not be allowed to grow, and a mellow surface should be maintained. In some seasons this may be effectually accomplished with one or two cultivations; in other seasons from four to six cultivations may be necessary.

Nothing can be gained by continuing cultivation in cornfields free from weeds and in which the soil surface is mellow. When the surface is sufficiently loose and dry to reduce evaporation, is open enough to prevent run-off, and no weeds are starting, a cultivation could do no good and if carelessly performed would do injury to the corn.

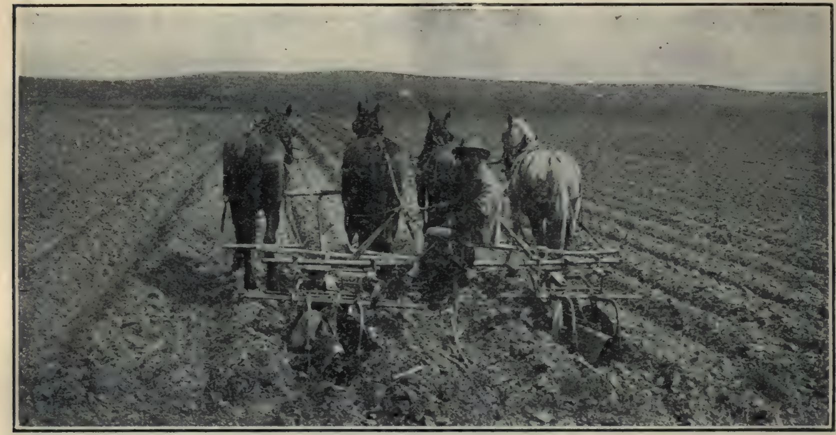

FIG. 11.—The first cultivation of listed corn at North Loup, Nebr. The row at the driver's feet will be cultivated on the return trip.

Corn should be cultivated only when one or more objects will be accomplished by the cultivation and when the total effects will be more beneficial than injurious.

Some beneficial effects are (1) preventing weeds from robbing the corn of soil moisture and fertility; (2) putting the surface in condition to take in rainfall, thus preventing run-off and erosion—losses of water and soil fertility; (3) warming the soil by drying its surface quickly; and (4) saving moisture by checking its capillary rise to the soil surface.

Some injurious effects are (1) breaking corn roots, which otherwise would use some of the moisture of light showers before it evaporates; and (2) forming large clods and holes, thus permitting dry air to enter and dry the soil.

CORN GROWING UNDER IRRIGATION.

The greatest natural limitations to corn growing under irrigation in many semiarid sections are short growing seasons and extreme differences between day and night temperatures. These effects may be partially overcome by growing early-maturing and adapted varieties, but it is not to be expected that as large yields can be secured as are possible in sections where the seasons are long and temperatures more uniform.

Many failures, however, are due to preventable causes. The most common mistakes are overirrigation, too frequent irrigations, too early irrigation, and too little cultivation. The farmer who has been accustomed to regard a shortage of moisture as the chief cause of crop failure too often concludes that irrigation will cure all ills and insure large yields.

When the surface soil is kept wet the temperatures are lowered by rapid evaporation, and the result is slower growth and delayed maturity. If cultivation be delayed until the surface soil begins to bake and crack, roots are exposed and cultivation may then be very injurious. (Fig. 13.)

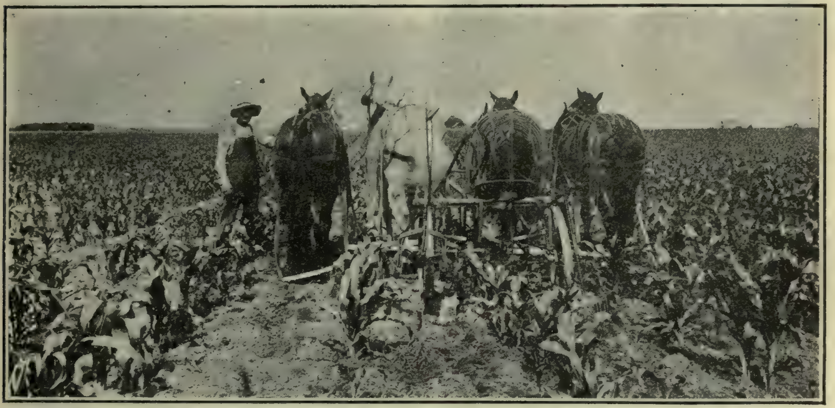

FIG. 12.—The second cultivation of listed corn at North Platte, Nebr.

Small corn plants do not require a large moisture supply. Early irrigations stimulate an excessive growth of stalk. The large, sappy stalks usually do not produce as much grain as those normally developed and are less likely to reach maturity before fall frosts occur.

On land that is well cultivated and kept free from weeds it is usually unnecessary to irrigate corn until about the time the tassels and silks begin to appear. A good supply of water is needed at this time, and irrigations are of much benefit to the plants in producing and developing ears. These irrigations should be thorough and followed as soon as possible by cultivation.

Irrigating in furrows or shallow ditches between the corn rows is better than flooding the whole surface and allowing the water to come in contact with the cornstalks.

The number of irrigations necessary depends upon the type of soil and the amount of moisture supplied by rain. On average loam soils two or three irrigations are usually sufficient. Late irrigations delay maturity.

ANIMAL AND INSECT ENEMIES.

Oftentimes in otherwise quite favorable locations the settlers' first attempts to grow corn are discouraging because the growing crop is destroyed by prairie dogs, ground squirrels, gophers, blackbirds, cutworms, earworms, wireworms, chinch bugs, or grasshoppers. The crop often starts well and is very promising before it is destroyed by some of these pests. This sometimes leaves the impression that the crop would have been a good one except for the pests.

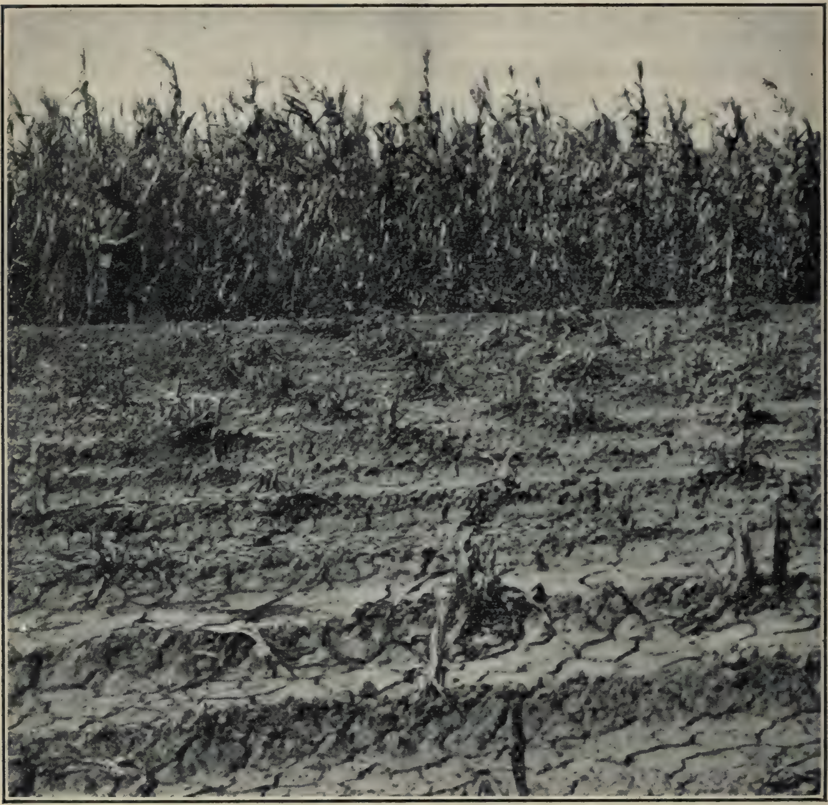

FIG. 13.—Corn cut away to show a baked and cracked soil. The corn should have been cultivated after the irrigation, as soon as the soil was sufficiently dry.

Where the chances are good that the crop will withstand the climatic and soil conditions, corn growing can be made to succeed notwithstanding the pests. Although they often destroy the small trial plats of a community, the injury from them usually diminishes from year to year as the corn acreage increases. Blackbirds, cutworms, gophers, etc., have for many years done damage to corn in the corn belt, but the crop is rarely destroyed entirely except in the case of small isolated fields.

Where cutworms, gophers, prairie dogs, or ground squirrels are obstacles to successful corn crops, poison should be used.

For cutworms, lumps of poisoned bait, made by mixing about 50 pounds of bran or corn meal with a pound of Paris green and enough cheap molasses to make a stiff dough, should be scattered along the corn rows at planting time or as soon as injury from cutworms is noticed.

Destruction by ground squirrels, prairie dogs, or gophers is best prevented by poisoning them a few weeks before the corn is planted. At this time they are readily killed by placing about their holes kernels of corn soaked in a solution of strychnine crystals. The corn may be poisoned by soaking it for a day or two in a solution made by dissolving about one-quarter of an ounce of strychnine crystals in a quart of denatured alcohol or boiling water.

Paris green and strychnine are poisons and should not be placed where children or domestic animals can get them.

PRINCIPLES GOVERNING THE CHOICE OF VARIETIES.

Although not especially suited to such regions because of its peculiar flowering habits and summer moisture requirements, corn will continue to be planted extensively in semiarid regions. Some of these plantings will fail, some will produce a little feed, and some will be more successful, depending upon the season, the soil, and the seed. The seasons are beyond control, the soil can be somewhat modified, and the seed can be greatly improved.

Corn has undergone great changes. Varieties exist which differ greatly in size, appearance, and requirements. Some varieties will mature with less heat and moisture than others, and some varieties more than others have the ability to withstand dry spells and revive when the drought is broken. For withstanding dry spells and cold, varieties which have been grown under these conditions for many years usually give the best results. The fittest have survived. Investigations and experiments now in progress indicate that varieties can be originated that will grow successfully at lower temperatures.

These adaptations and their limitations require attention in deciding what variety[1] of corn should be grown. These adaptations can be depended upon, but must not be expected to take the place of good preparation and cultivation of the soil. For example, in

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[1] The semiarid regions of the United States are too extensive to warrant the mention here of particular varieties. The reader is referred to reports of variety tests made at his nearest State experiment station or substation and to United States Department of Agriculture Bulletin 307, entitled "Tests of Corn Varieties on the Great Plains."

Montana varieties should be used that withstand cold, but the soil surface should nevertheless be kept dry and warm by shallow cultivation. Varieties respond to moisture storing and conserving methods by growing larger, maturing later, and yielding better. Seed which will produce cornstalks 4 feet tall under droughty conditions may produce stalks 10 feet tall under favorable conditions.

While some varieties of corn have more ability than others to withstand dry spells and revive when the drought is broken, this ability is possessed to a greater degree by the grain sorghums, making their use as a grain crop more certain in droughty regions having four months or more of hot weather. Where the hot growing season is limited to less than four months, the ability to wait during drought is not an advantage, and corn succeeds better than the grain sorghums.

Experienced farmers in southern States hold different opinions in regard to the advisability of planting northern-grown seed corn and seed of very quick maturing varieties. In some seasons such varieties make good crops before droughts occur, and slow-maturing varieties suffer or fail altogether. In other seasons the quick-maturing varieties suffer, and later rains cause the slow-maturing varieties to produce the better crop. The chances of hitting the season right are increased by growing both a quick-maturing and a slow-maturing corn. (Fig. 14.)

If good, sound grain is desired, large-growing varieties are generally less satisfactory in semiarid regions than the smaller varieties.

The most successful corn crops are produced by giving attention to the growing requirements with regard to moisture, heat, and soil conditions, and the use of varieties best adapted to the conditions under which they are grown.

NEED OF GOOD SOURCES OF SEED CORN.

The need of sources from which suitable seed corn can be obtained in the semiarid and Rocky Mountain regions is great and is increasing. Being a sparsely settled country, subject to extreme seasonal variations, seed of adapted varieties is much scarcer each year than in sections where the corn crop is more certain.

Nothing else would so cheaply turn many corn failures into successes as the establishment of good sources of seed corn. While a knowledge of corn breeding would be helpful,[1] any farmer can do much toward supplying himself and his neighborhood with better seed corn by starting with a well-tested variety and selecting the best ears from the best stalks each year. By so doing, natural selection assists in weeding out the unfit. Where corn is grown for grain, there is no better locality from which to obtain seed than that in which it is to be planted. Where grown for the silo or for large stalk growth, seed may be obtained to advantage from a more southern locality or a lower altitude.

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[1] Those especially interested in the improvement of corn by methods of breeding can receive detailed information upon application to the United States Department of Agriculture, Washington, D. C.

Farmers' Bulletin 415 of the United States Department of Agriculture, which may be obtained free upon application, treats of the selection and care of seed corn.

A point of greatest importance is that of holding over from good crops sufficient seed corn for two or three years' plantings. This is essential in the origination and perpetuation of high-yielding varieties adapted to local conditions. Seed corn that matures well and dries out promptly without injury will keep its good germinating and yielding power for four or five years. Seed corn of the best quality can be always available by protecting a sufficient quantity from moisture and from insects and other animals.

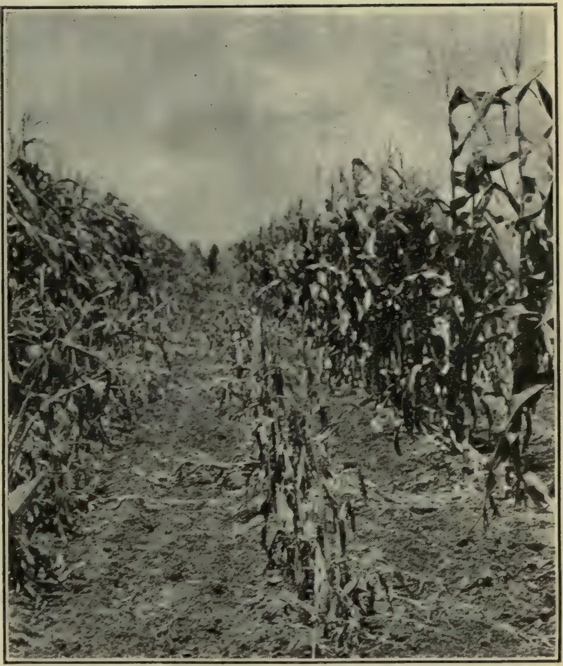

FIG. 14.—A western Texas cornfield, showing an early variety alternating with a late variety. The early crop sometimes matures before droughts occur, leaving the summer rainfall entirely to the other.

PASTURING CORN.

The practice of turning fattening animals into cornfields to harvest the crop is increasing and is likely to continue to increase. It usually pays better to allow hogs the privilege of harvesting the corn crop than to market it in any other way. This practice saves the labor of cutting, husking, hauling to the feed lot, and hauling the manure back on the land.

The pasturing of corn is especially applicable to semiarid regions. The dry soil is not injured by the animals, and very little corn goes to waste or spoils by coming in contact with the soil. The stalks are left in good shape to prevent the drifting of snow. (Fig. 15.)

Flint and flour varieties frequently produce heavier yields than dent varieties under droughty conditions. They are unpopular, however, on account of the many small ears and the difficulty of husking. When harvested by animals this difficulty is overcome.

CONCLUSIONS.

In the conservation of the resources of the United States the improvement of the acre yield of corn and a less wasteful utilization of this crop are important.

The average acre yield is less than half what it might easily be made. The acre yield is increasing in the older settled States, but for the nation it has remained at about 27 bushels. This has been largely due to the expansion of corn growing into semiarid and other unsuitable regions. The acre yield for the nation will quite certainly be increased. They will profit most who produce larger acre yields while the average is low.

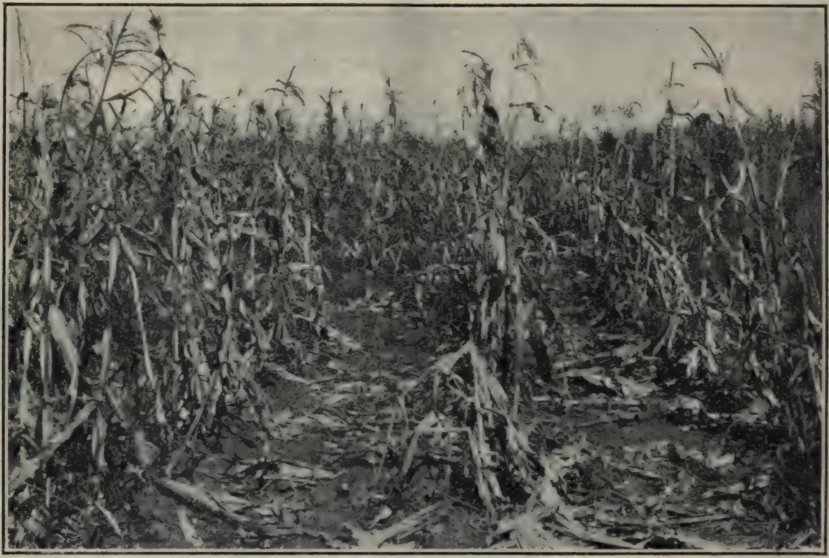

FIG. 15.—A portion of a South Dakota cornfield into which hogs have been turned to harvest the crop. It usually pays to allow hogs the privilege of harvesting corn.

While corn culture under droughty conditions is largely a matter of taking chances with seasonal conditions, certain controllable conditions of soil and seed often determine the success or failure of the crop.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

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Contribution from the Bureau of Biological Survey, Henry W. Henshaw, Chief.

GAME LAWS FOR 1916.[1]

A SUMMARY OF THE PROVISIONS RELATING TO SEASONS, EXPORT, SALE, LIMITS, AND LICENSES.

By T. S. PALMER, W. F. BANCROFT, and FRANK L. EARNSHAW,
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CONTENTS.

	Page.
Introduction	1
Review of legislation of 1916	2
New laws passed in 1916	7
Regulations for the protection of migratory birds	13
Treaty for the protection of migratory birds	18
Open seasons	21
Shipment of game	36
Sale of game	43
Disposition of game raised in captivity	48
Limits	50
Minimum age limits for hunting	53
Licenses for hunting game	54
Officials from whom State or Provincial game laws may be obtained	63

INTRODUCTION.

SCOPE OF THE BULLETIN.

The present bulletin, containing the seventeenth annual summary of the game laws of the United States and Canada, has been prepared on the same general plan as those issued each year since 1902. It includes a summary of the more important features of the new legislation, a brief synopsis of the new game laws enacted in each State and Province, and a series of tables showing the provisions relating to seasons, export, sale, limits, and licenses. It differs from other publications of game laws in several important points: (1) Inclusion of a brief review of the measures enacted, (2) arrangement of provisions by subjects instead of by States, and (3) adoption of a uniform statement and order of the various details to facilitate comparison of similar provisions in different States. Its chief objects are to present in convenient form the restrictions on hunting which affect the enforcement of the Federal statutes regulating interstate commerce in game and the protection of migratory birds, and to show the general condition and trend of legislation from year to year. Provisions relating to methods of capture, game refuges, enforcement of laws, disposition of fines and fees, and matters of special or local application are omitted. These can be found only by reference to the laws themselves or to the pamphlet editions of the game laws, obtainable in most States from the proper officials.[1]

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[1] This bulletin contains the proclamation of the President and the amended Regulations for the Protection of Migratory Birds, approved Aug. 21, 1916, and the treaty with Great Britain for the protection of migratory birds in the United States and Canada, ratified Aug. 29, 1916.

REVIEW OF LEGISLATION OF 1916.

The game legislation of 1916 is small in volume, only about 90 laws having been passed in the 11 States[2] and 5 Canadian Provinces which held legislative sessions this year. Although fewer game laws were enacted than last year, the record contains several progressive measures.

In Federal legislation the chief interest is naturally centered in the treaty with Great Britain for the protection of migratory birds in the United States and Canada, ratified on August 29 (see p. 18). Several acts relative to national parks were passed and several Executive proclamations and orders were issued affecting game. Among the latter probably the one of most general interest is the proclamation containing the new regulations for the protection of migratory birds. The amended regulations, finally adopted and approved on August 21, and based on the experience gained during the two years since the regulations were last amended, were prepared after careful consideration of many suggestions received from all parts of the country. The principal changes are as follows: Transfer of six States—West Virginia, Kentucky, Missouri, Kansas, Utah, and Nevada—from the southern zone to the northern zone, making 31 States in zone 1 and 17 in zone 2; permitting shooting on the Mississippi River above Memphis and on the Missouri River above Nebraska City; opening the season on certain shore birds during the last two weeks in August in New Jersey, Delaware, Maryland, and Virginia, and on reedbirds on and after September 1 in North Carolina and Georgia; opening the waterfowl season somewhat earlier in

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[1] See p. 63. Names and addresses are given in the Directory of Game Officials, published by the Biological Survey, U. S. Department of Agriculture (edition of 1916, B. S. Doc. 104).

[2] Georgia, Kentucky, Louisiana, Maryland, Massachusetts. Mississippi, New Jersey, New York, Rhode Island, South Carolina, and Virginia.

Massachusetts, New York, New Jersey, South Carolina, and Georgia; prohibiting shooting of migratory birds in every State after February 1; protecting wood ducks at all seasons throughout the United States instead of in zone 1; and protecting shore birds in California, and woodcock in Kentucky until 1918.

In State legislation more progress was probably made in Virginia and Mississippi than elsewhere, as in each of these States the office of game and fish commissioner was created, and resident licenses, game-protection funds, and warden service provided. This leaves only two States—Florida and Nevada—with no State officer to administer the game laws. In Mississippi, as in Alabama, the office of State game and fish commissioner is made elective after the term of the first incumbent expires, while in Virginia the work of game protection is placed in charge of the commissioner of fisheries, under the title of commissioner of game and inland fisheries. Maryland created a conservation commission and placed the administration of game laws under its charge; in Louisiana a reorganization resulted in the substitution of a single commissioner in charge of the department of conservation in lieu of a conservation commission of three members.

Kentucky protected deer and elk until 1921; wild turkeys, native and imported pheasants, and Hungarian partridges until 1920; and removed woodcock from the game list. Maryland protected deer and elk for six years, removed doves from the game list, and adopted the American Ornithologists' Union model law for the protection of nongame birds. In Canada, Manitoba protected swan, pelican, cormorant, whooping crane, wood duck, Hungarian partridge, and introduced species until 1920, and Ontario closed the season on grouse, prairie fowl, and partridge until 1918, and capercailzie until 1920.

Among the novel acts of the year may be mentioned that of New Jersey—in an effort to prevent accidents in the field—prohibiting a person from going into the woods or fields with firearms when under the influence of any drug or intoxicating liquor; and that of New York making it unlawful to pursue flocks of ducks in fresh water in such a manner as to drive them away from the neighborhood.

BIG GAME.

The changes affecting big game were not numerous, but a few are important. Georgia and Mississippi repealed their doe laws, thus permitting deer of either sex to be killed; New Jersey protected does and fawns, and permits one deer with horns visible above the hair to be killed by each hunter; in Alaska under regulations of the department only deer having horns 3 inches or more in length may be killed. New York opened the season on deer in Oneida, Lewis, and Jefferson Counties west of the Utica & Black River Railroad from Utica to Ogdensburg. In Alaska protection on moose and sheep on the Kenai Peninsula was extended for two years, and goats were protected for two years.

In Canada, Nova Scotia permits deer hunting this season for the first time[1] by providing an open season on bucks during the last 11 days of October except on Cape Breton Island. Manitoba lengthened the season 5 days on big game but opened the season on November 20, 10 days earlier than formerly, while Ontario lengthened the deer season 2 weeks (north of the main line of the Canadian Pacific) and shifted the season on moose and caribou, thus making the month of November a uniform open season on big game.

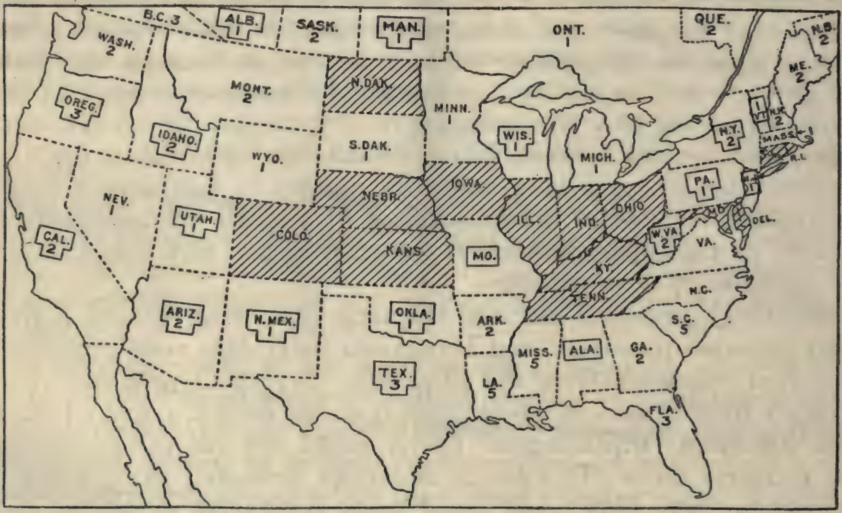

FIG. 1.—States and Provinces which permit deer hunting, protect does throughout the year, and limit the number of deer which may be taken by each hunter.

[Shaded areas indicate the States in which there is no deer hunting; inclosed names, the States which protect does at all seasons; and figures, the number of deer allowed each hunter during a season. In the eastern half of Maine and southern half of New Hampshire the limit is 1 a season. In Alabama, Mississippi, and Missouri the limit is 1 a day, and in Louisiana 2 a day.]

Under present conditions deer hunting is permitted in 36 States, in about a third of which the hunter is limited to one deer a season and in most others to two. Sixteen States and Alaska protect does at all seasons and allow only bucks to be killed—namely, Alabama, Arizona, California, Idaho, Missouri, New Jersey, New Mexico, New York, Oklahoma, Oregon, Pennsylvania, Texas, Utah, Vermont, West Virginia, Wisconsin, and Alaska. Pennsylvania requires that deer killed shall have horns 2 inches above the hair; New Jersey, visible above the hair; Utah, visible above the head; New York, Vermont, and Alaska, at least 3 inches long; and West Virginia, 4 inches long; while California prohibits entirely the killing of spike bucks.

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[1] Deer have extended their range to Nova Scotia comparatively recently. One of the first recorded was killed at Liscomb Lake in December, 1886 (Forest and Stream, xxvii, p. 467, 1887).

OPEN SEASONS.

Aside from the changes in the regulations under the migratory bird law already mentioned, changes in open seasons were comparatively few in number. In Kentucky the open season on doves was shortened from five months to six weeks, thus abolishing summer shooting; in Maryland doves were removed from the game list under the new nongame-bird law, and spring shooting of waterfowl was curtailed by closing the season on March 15[1] instead of April 10; in New Jersey a season uniform with that on waterfowl was provided for coots or crow-bill ducks; and Virginia repealed all laws in conflict with the Federal migratory bird law.

EXPORT AND SALE.

Kentucky now prohibits the export of all protected game, but allows a hunter to carry home game he has lawfully killed and forbids the sale of quail, ruffed grouse, wild turkeys, imported pheasants, and Hungarian partridges, whether taken in or out of the State.

Maryland prohibits the export of all game except waterfowl.

New York amended the law regulating transportation of big game so as to permit moose, elk, caribou, and antelope killed in private preserves to be transported at any time instead of during the open season for deer; added gray partridges to the list of game birds that may be imported for sale under license; permitted game breeders in States having a breeders' law similar to that of New York to import game for market purposes under a $5 license and cost of inspection, and allowed the sale for food purposes of varying hares and cottontail rabbits bred in captivity under license, if duly tagged.

Rhode Island prohibited possession of game, the sale of which is prohibited, by dealers in poultry, meats, groceries, or other products.

Manitoba reduced the number of geese a nonresident hunter may take out under his license from 100 to 50, provided a 25-cent export permit, and prohibited the sale of all protected game except hides and heads of big game.

Ontario empowered the Minister of Public Works to grant permits for the export of any game whether dead or alive, and prohibited the sale of waterfowl.

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[1] Under the Federal regulations it closes Feb. 1.

BAG LIMITS.

Georgia reduced the number of deer and turkeys that may be taken from 3 to 2 each a season, and prescribed a limit of 15 a day on cat squirrels. Kentucky, for the first time, placed restrictions on the quantity of game that may be taken, by providing bag limits of 12 quail and 15 doves per day, and limiting the number in possession for consecutive days hunted to a multiple of the daily limit on each species. Maryland restricted the number of waterfowl to 25 a day, the first limit on waterfowl applicable throughout the State, and also reduced other limits generally. Mississippi restricted the killing of squirrels to 10 a day.

Manitoba reduced the limit on ptarmigan, prairie chicken, and partridge from 20 to 15 a day and from 100 to 50 a season, and on ducks from 50 to 40 a day after October 1.

LICENSES.

The most important license legislation was the adoption of resident licenses in Mississippi and Virginia, each State adopting the dual system of county and State-wide licenses. Louisiana abolished the free ward and county system, thus requiring every one who hunts to obtain a license, and reduced the State license fee from $3 to $1; and Kentucky reduced the fee for a nonresident or alien license from $15 to $7.50 and repealed the provision which permitted a resident landowner to hunt on adjoining farms without a license. New York reduced the fee for a nonresident or alien license from $20 to $10.

In Canada, Ontario reduced the nonresident license fee from $50 to $25, and abolished the special nonresident license for birds. Saskatchewan increased the fee from $1 to $1.25 for the license required of residents of cities and towns, but reduced the fees for nonresident licenses—for a general license from $50 to $25, for a bird license from $25 to $10, and for a six-day license from $10 to $2.50.

GAME REFUGES AND PRESERVES.

Notwithstanding the small volume of legislation, considerable progress was made in the matter of game preserves, both Federal and State. Two new national parks, one on Mount Lassen, Cal., and the other on Mount Kilauea, in Hawaii, were established by Congress; bills were passed accepting the cession of State jurisdiction over the Crater Lake, Oreg., and Mount Rainier, Wash., National Parks, with provision for resident commissioners and enforcement of the laws, and amending the Yellowstone Park act so as to facilitate protection of the park and prevent poaching. Provision has also been made for the establishment of game preserves on lands purchased for the Appalachian Forest. Under Executive proclamation the Sieur de Monts National Monument of some 5,000 acres on Mount Desert Island in Maine was created on July 8; and by Executive orders two new bird reserves were established, one on Goat Island, in San Francisco Bay, Cal., on August 9, and the other, comprising four lakes on the Platte reclamation project in Nebraska, on August 21.

Congress has donated to the State of Kansas certain lands in the former Kansas National Forest for a game preserve for the protection of a herd of antelope; and Virginia has prohibited hunting on all lands in the Massanutten purchase in the Appalachian Forest in Shenandoah County, thus making this area in effect a game refuge; New Jersey has authorized the expenditure of $5,000 for the purchase of additional lands for the State game farm, and the creation of game preserves on private lands, by agreement, in Sussex and Warren Counties.

In Canada, Manitoba has established seven new game preserves, including Cedar Lake, Doghead Point, Grindstone Point, Lake St. Martin, Peonan Point, Red Deer Point, and Reindeer Island, comprising 3,950 sections of land; Saskatchewan has created an additional Cypress Hills preserve, and also the Pasquia, Big River, and North and South Saskatchewan Rivers game preserves, but reduced the areas of game preserves on forest reservations owing to complaints from sportsmen that the law which automatically makes all forest reserves game refuges circumscribed the hunting area.

NEW LAWS PASSED IN 1916.

Federal laws.—Nine acts: Granting to the State of Kansas certain lands in the Kansas National Forest in Finney County for a State game preserve (64th Cong., Pub. No. 102); amending the Yellowstone Park act by reducing the penalty and thus giving the commissioner jurisdiction over certain misdemeanors committed within the park (Pub. No. 115); accepting cession by the State of Washington of exclusive jurisdiction over lands in the Mount Rainier National Park (Pub. No. 124); establishing the Hawaii National Park on the Island of Hawaii (Pub. No. 171), and the Lassen Volcanic National Park in California (Pub. No. 184); accepting cession by the State of Oregon of exclusive jurisdiction over lands in the Crater Lake National Park (Pub. No. 223); creating the National Park Service for the administration of national parks and monuments (Pub. No. 235); provisions in the Agricultural appropriation bill increasing the appropriation for maintenance of bird and game reservations from $21,000 to $25,000, continuing the appropriation of $50,000 for the protection of migratory birds; and authorizing the President to designate such areas on lands acquired in the Appalachain region as should, in his opinion, be set aside for the protection of game animals, birds, or fish (Pub. No. 190, pp. 24, 25, 34); and the treaty with Great Britain ratified by the Senate (Sen. Exec. Doc. E).

Migratory bird regulations.—(See p. 13.)

Alaska.—By regulation: Prohibiting the killing of moose and sheep on the Kenai Peninsula and shipment of said animals therefrom for sale; protecting deer on Duke, Gravina, Kodiak, Long, Kruzof, Suemez, and Zarembo Islands, and adding San Juan to the list; affording protection to goats, female deer, and fawns in southeastern Alaska, and permitting only deer with horns 3 inches long to be killed, all effective until 1918 (S. R. A.—B. S. 10); prohibiting sale of moose or sheep south of lat. 62° and between lon. 141° and lon. 155° until 1918 (S. R. A.—B. S. 12).

Georgia.—One act: Containing several important amendments affecting squirrels and doves, opening the season on female deer, and providing for possession of game for propagating purposes.

Kentucky.—Three acts: Reducing the nonresident or alien license fee from $15 to $7.50; increasing the maximum penalty for hunting without a license from $100 to $200; repealing the provision permitting a resident landowner to hunt on adjoining farms without a license; authorizing, in case of conviction, the levy and collection of a fee of $5 for the informer (S. B. 134); shortening the season on doves from five months to six weeks; prohibiting all hunting of woodcock; closing the squirrel season on December 16, thus abolishing late winter shooting; reducing the open season on rabbits to two and a half months, thus prohibiting late winter and summer shooting; protecting wild turkey, native pheasant (ruffed grouse), imported pheasants, and Hungarian partridges until 1920; prohibiting sale of quail, ruffed grouse, wild turkey, imported pheasants, and Hungarian partridges, whenever caught or killed; prohibiting export of all protected game, except game lawfully killed and in possession of a hunter, and under permit, birds or animals raised in captivity or which have been purchased for propagation; creating a bag limit of 12 a day on quail, and limiting the number in possession to 12 for each successive day's hunt; limiting the bag on doves to 15 a day and possession to 15 for each successive day's hunt; providing that game birds or animals bred or reared in captivity may be disposed of by owner or propagator, under permit of game and fish commissioner, without reference to the game laws, and the dead body of any bird or animal lawfully reared in captivity may be sold when properly tagged; protecting deer and elk until 1921, and prohibiting hounding (ch. 31).

Louisiana.—Five acts: Substituting a single commissioner in charge of the department of conservation in lieu of the conservation commission of three members (act —); abolishing free wards and separate parish licenses for residents, requiring all residents who hunt to be licensed, and reducing the fee for a State-wide license from $3 to $1 (act —); shifting the open season on quail and wild turkey gobblers, which formerly began on November 1, to November 15; lengthening the season a month on jacksnipe, and closing the season until November 1, 1920, on prairie chicken, imported peasants, wild turkey hen, upland plover, papabotte, and killdeer; repealing the law that permitted the killing of 50 sea gulls a day from August 1 to February 1 and placing the birds on the protected list (act —); enacting a comprehensive game-breeders' law, permitting game to be raised in captivity under $5 license and sold for food purposes; permitting sale of squirrels during open season.

Maryland.—Ten general acts: Changing the season on squirrels (ch. 143); enacting a State-wide law prohibiting the export of all game except waterfowl, but allowing a licensed hunter to take out an amount equal to one day's bag limit, if killed by himself and not for sale (ch. 215); enacting a comprehensive, model law for the protection of nongame birds, defining game, removing doves from the game list, prohibiting the sale of plumage, providing for the issuance of a $1 permit for scientific collecting, and specifically exempting starlings from protection (ch. 385); strengthening the law in regard to the powers of the warden or his deputies as to search and seizure (ch. 386); protecting elk and deer for 6 years (ch. 399); further restricting the use of power boats in hunting waterfowl (ch. 542); reducing bag limits generally and providing a limit of 25 a day on waterfowl (ch. 545); closing the State season on waterfowl on March 15 instead of April 10, but permitting possession until March 25 (ch. 568); permitting the killing of English or ring-necked pheasants raised in captivity (ch. 595); placing the office of State game warden and the administration of the game laws under a conservation commission of three members (ch. 682).

Fifteen local acts: Protecting deer in Garrett County until 1922 (ch. 10); making it unlawful to shoot waterfowl in certain parts of Harford County after sunset (ch. 89; see also ch. 383); protecting introduced pheasants and ruffed grouse until 1921 in Wicomico County (ch. 91); protecting quail until 1921 in Frederick County, but permitting propagation and free shipment thereof (ch. 96); regulating seasons and sale in Cecil County (ch. 97); abolishing the office of county game warden and repealing the provision for resident licenses in Caroline County (ch. 99); prescribing nonresident licenses of $5.50 for residents of the State, and $20.50 for nonresidents of the State in Howard County (ch. 100); repealing an obsolete game law in Caroline County (ch. 268); prescribing licenses for residents of county and State, and reducing the nonresident license fee from $10.50 to $5 Allegany County (ch. 282); requiring residents in Harford County to obtain hunting licenses, and creating the office of county game warden (ch. 307); requiring a 50-cent license of residents in Washington County (ch. 320); requiring resident and nonresident licenses in Anne Arundel County (ch. 366); protecting waterfowl in certain localities in Cecil County after sunset (ch. 383; see also ch. 89); reenacting a comprehensive game law in Frederick County (ch. 404); regulating the appointment of a game warden in Baltimore County (ch. 421).

Massachusetts.—Four acts: Providing a penalty of $10 to $50 for hunting birds or quadrupeds with firearms, other than shotguns during the open season for deer (ch. 7); providing close seasons throughout the year on heath hens, doves, upland plover, gulls, and terns (ch. 15); authorizing the issuance of hunting licenses to minors under the age of 18, with written consent of parent or guardian, at the discretion of the clerk who issues licenses (ch. 74); extending the prohibitions against hunting waterfowl and shore birds with traps, artificial lights, and power boats to all game (ch. 110).

Mississippi.—One act:[1] Creating the department of game and fish, authorizing the election of a State game and fish commissioner at the close of the term of the first commissioner appointed by the governor; providing a system of resident and nonresident hunting licenses and establishing a game and fish protection fund; authorizing the appointment of county wardens and deputies; removing protection from does, shortening the season two and one-half months on deer, two months on bear, and one month on quail, and lengthening the season six weeks on turkey gobblers; and requiring written permission to hunt on the cultivated or inclosed lands of another. (S. B. 252.)

New Jersey.—Six acts: Making the open season on coots or crow-bill ducks uniform with that on waterfowl (ch. 30); prohibiting a person from going into the woods or fields with a gun or firearms when intoxicated or under the influence of any drug (ch. 130); authorizing additional lands for the State game farm, and limiting the expenditure to $5,000 (ch. 138); protecting does and fawns and permitting the killing only of deer with horns visible above the hair (ch. 262); empowering board of game commissioners to establish refuges by contract on private lands in Sussex and Warren Counties, and making it unlawful to carry shotgun or rifle on such refuges except by permit (ch. 286); authorizing the appointment of a commission of seven members to codify the State game and fish laws, and limiting the expenses to $600 (J. Res. 8).

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[1] A petition for a referendum of the game law, under the constitutional amendment passed by the last legislature, was filed in the office of the secretary of state on June 8, but an injunction was granted by the lower court enjoining the secretary of state from action. This injunction was made permanent by the lower court, which held that the referendum amendment was never adopted by the people. The case is now on appeal before the Supreme Court of Mississippi.

New York.—Eight acts: Permitting museums and collectors to possess the plumage, skins, or bodies of protected wild birds (ch. 77); providing that a majority of the common council of any city may request the conservation commission to make desired changes in close seasons on fish and game (ch. 155); authorizing county clerks to retain their fees for issuing licenses when making returns to the commission (ch. 297); adding European gray-legged partridge to the list of game birds that may be imported for sale under license of the commission (ch. 402); making it unlawful to hunt in an automobile or with the aid of automobile headlights (ch. 404); prohibiting taking game on roads in private preserves in forest preserve counties (ch. 405); authorizing breeders of domesticated American elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, and mallard and black ducks for sale to be licensed to import them for market purposes into New York State on paying a fee of $5 and costs of inspection (ch. 406); amending and revising the conservation law generally, making many important changes; authorizing compromise of cases before magistrates, but requiring a full record of each case to be made; empowering protectors to examine automobiles or other vehicles without search warrant where they have reason to believe that game or birds are possessed in violation of law; reducing the nonresident or alien license fee from $20 to $10, thus abolishing the special $10 license for nonresident taxpayers; requiring licensee to wear in a conspicuous place on his clothing a button, 2 inches in diameter, bearing the number of his hunting license; opening the season on deer in Oneida, Lewis, and Jefferson Counties west of the Utica & Black River Railroad from Utica to Ogdensburg; prescribing a license, fee $1, for dogs that are to be taken into forests inhabited by deer; permitting moose, elk, caribou, and antelope killed by owner thereof in a private park to be possessed or transported at any time, instead of during the open season for deer; permitting the sale for food purposes during the close season of varying hares and cottontail rabbits bred in captivity, under $5 license, if duly tagged; permitting the use of rowboat in pursuit of wounded birds; making it unlawful to pursue flocks of ducks in fresh water so as to drive them away from any neighborhood; permitting game birds to be possessed, except on Long Island, for five days after the closing of the season; removing protection from great blue herons and bitterns (ch. 521).

Rhode Island.—One act: Removing protection from starlings, their nests, and eggs; strengthening provisions in regard to powers and duties of commissioners and deputies; prohibiting possession of game, the sale of which is prohibited, by any person dealing in poultry, meats, groceries, or other provisions; and reducing the penalty for violations (ch. 1385).

South Carolina.—Nine local laws:[1] Extending license requirements in certain counties (Nos. 417, 428, 432), changing seasons on deer in Sumter, Clarendon, Colleton, and Richland Counties (Nos. 429, 434, 436), and on partridges in Fairfield, Lancaster, Abbeville, York, and Union Counties (Nos. 435, 438, 439).

Virginia.—Twenty-one acts: Three general and 18 local acts; creating a department of game and fish, providing warden service, prescribing resident

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[1] At the date of publication of the session laws the act providing for the election of a chief game warden by the people had not been signed by the governor.

State and county licenses and a special alien license, but permitting landowners, tenants, and members of their families to hunt on their own or adjoining lands without license; creating a game protection fund; requiring written permission to hunt on the posted lands of another; and repealing all laws in conflict with the Federal migratory bird law (ch. 152); strengthening the nongame bird law and prohibiting the sale of plumage (ch. 54); prohibiting the sale of wild turkeys (ch. 58).

Eighteen local laws: Requiring written permission in Loudoun County to hunt on lands of another (ch. 19); shifting the season on deer in Mecklenburg County (ch. 52); protecting deer for five years in Bath and Highland Counties (ch. 88); closing the season on deer for five years in Buckingham County (ch. 118); closing the season on deer for three years in Cumberland County (ch. 119); protecting deer and elk for four years in Shenandoah County, and making it unlawful to chase them with dogs, sell, or have them in possession (ch. 143); affording protection to squirrels in the counties of Caroline, Charles City, James City, New Kent, Spotsylvania, Stafford, Warwick, and York and fixing the open season from November 1 to February 1 (ch. 145); protecting ring-necked pheasants until 1920 in Shenandoah County (ch. 161); protecting deer for three years in Augusta County (ch. 175); protecting rabbits in the snow in Mathews and Middlesex Counties (ch. 176); shifting the season on deer in Chesterfield County (ch. 191); prescribing bag limits on upland birds in Shenandoah County (ch. 219); extending protection on pheasants until 1919 in Middlesex County (ch. 232); protecting quail, pheasant, dove, lark, and song birds for two years in Lee County (ch. 243); requiring written permission in Amherst County to hunt on posted lands of another (ch. 244); limiting the amount of game that a hunter may take out of Shenandoah County (ch. 251); providing a close season on squirrels in Shenandoah County (ch. 262); protecting game until 1921 in the areas known as the Massanutten purchase acquired by the United States under the law for the acquisition of lands upon the head waters of navigable streams (ch. 348).

British Columbia.—By regulation: Closing the season on bull moose in the Skeena electoral district and opening the season on bull moose in Fort George and Omineca electoral districts; shortening the deer season two weeks on Vancouver Island and in Islands electoral district; protecting female of mule deer throughout Province; opening the season on male sheep in North and South Okanogan electoral districts; closing the season on quail throughout the Province, except for a week in the district municipality of Penticton; shortening the season four weeks on male pheasants in certain districts; revoking the regulations permitting the sale of deer, snipe, ducks, and geese.

Manitoba.—One act: Lengthening the season on big game 5 days and opening the season November 20 instead of December 1; reducing limits on ptarmigan, prairie chicken, and partridge, from 20 to 15 a day and from 100 to 50 a season and on ducks after October 1, from 50 to 40 a day; protecting swan, pelican, cormorant, whooping crane, wood duck, Hungarian partridge, and introduced species until 1920; permitting wild ducks and geese to be shot from grain-stubble fields at night; extending the law prohibiting the carrying of loaded shotgun or rifle to include railway vehicles, and holding the liveryman, chauffeur, or person in charge of the conveyance responsible for the actions of the occupant of his conveyance; reducing the time grouse, ptarmigan, prairie chicken, or partridge may be had in possession in close season from 45 days to 10 days after end of open season; prohibiting sale of all protected game, except heads and hides of big game; reducing the number of geese which may be exported under nonresident license from 100 to 50; permitting nonresident licensee to export carcass of one big game animal under free permit and hunting license; repealing the provision permitting the export of the entire carcass of big game animals and prescribing 25-cent permit for the export of part of a carcass of any big game; prescribing licenses for training dogs on birds; authorizing the lieutenant governor in council to appoint two game commissioners, and transferring the power to appoint game guardians from the lieutenant governor in council to the minister of agriculture and immigration; setting aside seven new game preserves, including Cedar Lake, Doghead Point, Grindstone Point, Lake St. Martin, Peonan Point, Red Deer Point, and Reindeer Island, comprising 3,950 sections of land (ch. 44).

Nova Scotia.—One act: Opening the season on male deer, except on Cape Breton Island, from October 21 to 30, inclusive; shortening the season two months on all waterfowl except black, harlequin, golden-eye, and scaup ducks, and one month on quail, rail, coot, and shore birds.

Ontario.—One act: Defining the term "nonresident" to mean any person domiciled in the Province for a period of less than six months; requiring a $5 license of residents, except farmers or farmers' sons on their own lands, to trap fur-bearing animals; closing the season on grouse, prairie fowl, and partridge until 1918; permitting hares to be taken by any means from October 15 to November 15 and from December 23 to January 2 and at any other time by means other than shooting; making it unlawful to permit any bird or animal suitable for food to be destroyed or spoiled; limiting a hunter to one flock of not more than 50 decoys, or two flocks nearer each other than 100 yards; prohibiting the sale of all wild waterfowl; authorizing minister to grant permits to take game or fur-bearing animals in close season for propagating or scientific purposes, and for the export of any game whether alive or dead; lengthening the season two weeks on deer north of main line of Canadian Pacific, shifting the season on moose and caribou, thus making the month of November the uniform season on big game; shortening the season two weeks on woodcock by opening October 15; extending the close season on capercailzie until 1920; making it unlawful to hunt, kill, or willfully put to flight any waterfowl that are more than 200 yards from the shore or natural rush bed thick enough to conceal a boat, or from a water line bounding private property; making it unlawful to take, destroy, or possess eggs of game birds except under permit of the minister to engage in the business of propagating game birds; reducing the fee for a nonresident general license from $50 to $25, and revoking the order in council prescribing a $25 nonresident license for birds (ch. 60).

Quebec.—One act: Prescribing a penalty of $100 and costs for a gamekeeper, special officer, or game guardian who commits an infringement of the game laws (ch. 21).

Saskatchewan.—One act: Permitting cow moose to be killed, limiting the number of cow moose and bull elk to one each a season, but only two big-game animals may be taken a season; lengthening the season two weeks on big game; shortening the season two weeks on prairie chicken, making it unlawful to kill swans, and protecting sage grouse, ruffed grouse, partridge, Canada grouse, and spruce grouse until 1918; prohibiting the use of silencers and declaring that a gun with cartridges in the magazine only shall not be deemed to be loaded; prohibiting the sale of all game; requiring a $2 annual license of cold-storage companies handling game and making it unlawful to store game birds from March 1 to September 16 and the flesh of big game from April 1 to December 1; increasing the fee for the license required of residents of city or town from $1 to $1.25; reducing the fee for nonresident licenses as follows—general license, from $50 to $25; season bird license, from $25 to $10; six-day license, from $10 to $2.50; reducing the area of game preserves on forest reservations (ch. 30).

REGULATIONS FOR THE PROTECTION OF MIGRATORY BIRDS.[1]

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA, A PROCLAMATION.

WHEREAS, an Act of Congress approved March fourth, nineteen hundred and thirteen, entitled "An Act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and fourteen" (37 Stat., 847), contains provisions as follows:

> All wild geese, wild swans, brant, wild ducks, snipe, plover, woodcock, rail, wild pigeons, and all other migratory game and insectivorous birds which in their northern and southern migrations pass through or do not remain permanently the entire year within the borders of any State or Territory, shall hereafter be deemed to be within the custody and protection of the Government of the United States, and shall not be destroyed or taken contrary to regulations hereinafter provided therefor.
>
> The Department of Agriculture is hereby authorized and directed to adopt suitable regulations to give effect to the previous paragraph by prescribing and fixing closed seasons, having due regard to the zones of temperature, breeding habits, and times and line of migratory flight, thereby enabling the department to select and designate suitable districts for different portions of the country, and it shall be unlawful to shoot or by any device kill or seize and capture migratory birds within the protection of this law during said closed seasons, and any person who shall violate any of the provisions or regulations of this law for the protection of migratory birds shall be guilty of a misdemeanor and shall be fined not more than $100 or imprisoned not more than ninety days, or both, in the discretion of the court.
>
> The Department of Agriculture, after the preparation of said regulations, shall cause the same to be made public, and shall allow a period of three months in which said regulations may be examined and considered before final adoption, permitting, when deemed proper, public hearings thereon, and after final adoption shall cause the same to be engrossed and submitted to the President of the United States for approval: *Provided, however*, That nothing herein contained shall be deemed to affect or interfere with the local laws of the States and Territories for the protection of nonmigratory game or other birds resident and breeding within their borders, nor to prevent the States and Territories from enacting laws and regulations to promote and render efficient the regulations of the Department of Agriculture provided under this statute.

WHEREAS, the Department of Agriculture has duly prepared suitable regulations to give effect to the foregoing provisions of said Act and after the preparation of said regulations has caused the same to be made public and has allowed a period of three months in which said regulations might be examined and considered before final adoption and has permitted public hearings thereon;

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[1] As amended by the proclamation of August 21, 1916.

And, WHEREAS, the Department of Agriculture has adopted the regulations hereinafter set forth and after final adoption thereof has caused the same to be engrossed and submitted to the President of the United States for approval;

Now, THEREFORE, I, WOODROW WILSON, President of the United States of America, by authority in me vested do approve and hereby proclaim and make known the following regulations for carrying into effect the foregoing provisions of said Act:

REGULATION 1.—DEFINITIONS.

For the purposes of these regulations the following shall be considered migratory game birds:

(*a*) Anatidæ or waterfowl, including brant, wild ducks, geese, and swans.

(*b*) Gruidæ or cranes, including little brown, sandhill, and whooping cranes.

(*c*) Rallidæ or rails, including coots, gallinules, and sora and other rails.

(*d*) Limicolæ or shore birds, including avocets, curlew, dowitchers, godwits, knots, oyster catchers, phalaropes, plover, sandpipers, snipe stilts, surf birds, turnstones, willet, woodcock, and yellowlegs.

(*e*) Columbidæ or pigeons, including doves and wild pigeons.

For the purposes of these regulations the following shall be considered migratory insectivorous birds:

(*f*) Bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, hummingbirds, kinglets, martins, meadowlarks, nighthawks or bull bats, nuthatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, waxwings, whippoorwills, weedpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects.

REGULATION 2.—CLOSED SEASON AT NIGHT.

A daily closed season on all migratory game and insectivorous birds shall extend from sunset to sunrise.

REGULATION 3.—CLOSED SEASON ON INSECTIVOROUS BIRDS.

A closed season on migratory insectivorous birds shall continue throughout each year, except that the closed season on reedbirds or ricebirds in New Jersey, Pennsylvania, Delaware, Maryland, the District of Columbia, Virginia, North Carolina, South Carolina, and Georgia shall commence November 1 and end August 31, next following, both dates inclusive: *Provided*, That nothing in this or any other of these regulations shall be construed to prevent the issue of permits for collecting birds for scientific purposes in accordance with the laws and regulations in force in the respective States and Territories and the District of Columbia.

REGULATION 4.—CLOSED SEASONS ON CERTAIN GAME BIRDS.

A closed season shall continue until September 1, 1918 on the following migratory game birds: Band-tailed pigeons, little brown, sandhill, and whooping cranes, wood ducks, swans, curlew, willet, and all shore birds except the black-breasted and golden plover, Wilson snipe or jacksnipe, woodcock, and the greater and lesser yellowlegs.

A closed season also shall continue until September 1, 1918 on rails in California and Vermont and until October 1, 1918 on woodcock in Illinois, Kentucky, and Missouri, and until September 1, 1918 on black-breasted and golden plover and greater and lesser yellowlegs in California and Utah.

REGULATION 5.—ZONES.

The following zones for the protection of migratory game and insectivorous birds are hereby established.

Zone No. 1, the breeding zone, comprising the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Kentucky, West Virginia, Michigan, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Nebraska, Kansas, Missouri, Colorado, Wyoming, Montana, Idaho, Utah, Nevada, Oregon, and Washington—31 States.

Zone No. 2, the wintering zone, comprising the States of Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, Texas, Oklahoma, New Mexico, Arizona, and California—17 States and the District of Columbia.

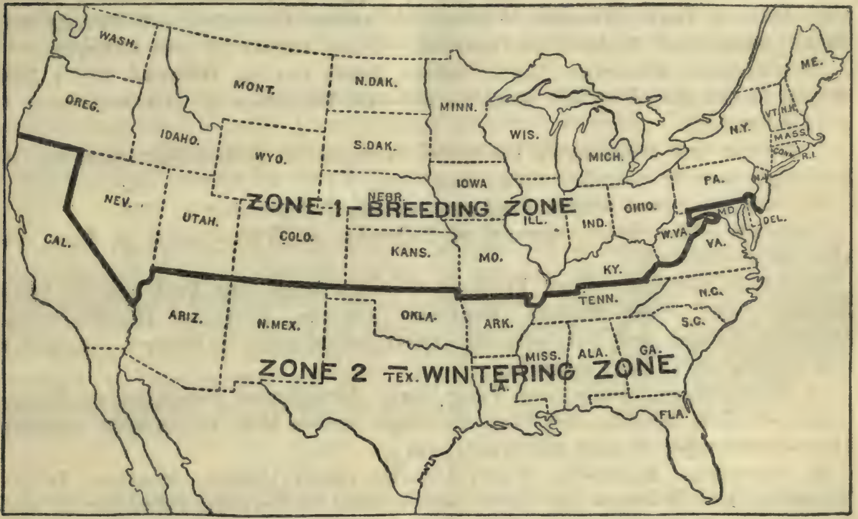

FIG. 2.—Zones adopted under Federal law protecting migratory birds.

REGULATION 6.—CONSTRUCTION.

For the purpose of regulations 7 and 8 each period of time therein prescribed as a closed season shall be construed to include the first and last day thereof.

REGULATION 7.—CLOSED SEASONS IN ZONE NO. 1.

Waterfowl, Coots and Gallinules.—The closed seasons on waterfowl, coots and gallinules in Zone one shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts, New York (except Long Island), Ohio, Michigan, Indiana, Kentucky, West Virginia, Illinois, Iowa, Kansas, Nebraska, and Missouri the closed season shall be between January 1 and September 15 next following;

In Wisconsin, Minnesota, North Dakota, South Dakota, Montana, Idaho, Wyoming, and Colorado the closed season shall be between December 21 and September 6 next following; and

In Rhode Island, Connecticut, Long Island, New Jersey, Pennsylvania, Washington, Oregon, Utah, and Nevada the closed season shall be between January 16 and September 30 next following.

Rails, other than Coots and Gallinules.—The closed season on sora and other rails, excluding coots and gallinules, in Zone one shall be between December 1 and August 31 next following, except as follows:

> Exception: In Vermont the closed season shall continue until September 1, 1918.

Black-breasted and golden plover and greater and lesser yellowlegs.—The closed seasons on black-breasted and golden plover and greater and lesser yellowlegs in Zone one shall be as follows:

In Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey the closed season shall be between December 1 and August 15 next following;

In Vermont, Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Michigan, Illinois, Iowa, Missouri, Kansas, Nebraska, Colorado, and Nevada the closed season shall be between December 16 and August 31 next following;

In Wisconsin, Minnesota, North Dakota, South Dakota, Montana, Idaho, and Wyoming the closed season shall be between December 21 and September 6 next following;

In Oregon and Washington the closed season shall be between December 16 and September 30 next following; and

In Utah the closed season shall continue until September 1, 1918.

Jacksnipe.—The closed seasons on jacksnipe or Wilson snipe in Zone one shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts, New York (except Long Island), Ohio, West Virginia, Kentucky, Indiana, Michigan, Illinois, Iowa, Missouri, Kansas, and Nebraska the closed season shall be between January 1 and September 15 next following;

In Rhode Island, Connecticut, Long Island, New Jersey, Pennsylvania, Washington, Oregon, Nevada, and Utah the closed season shall be between January 16 and September 30 next following; and

In Wisconsin, Minnesota, North Dakota, South Dakota, Montana, Idaho, Wyoming, and Colorado the closed season shall be between December 21 and September 6 next following.

Woodcock.—The closed season on woodcock in Zone one shall be between December 1 and September 30 next following, except as follows:

> Exceptions: In Illinois, Kentucky, and Missouri the closed season shall continue until October 1, 1918.

REGULATION 8.—CLOSED SEASONS IN ZONE NO. 2.

Waterfowl, Coots and Gallinules.—The closed seasons on waterfowl, coots and gallinules in Zone two shall be as follows:

In Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana the closed season shall be between February 1 and October 31 next following; and

In Oklahoma, Texas, New Mexico, Arizona, and California the closed season shall be between February 1 and October 15 next following.

Rails, other than Coots and Gallinules.—The closed season on sora and other rails, excluding coots and gallinules, in Zone two shall be between December 1 and August 31 next following, except as follows:

> Exceptions: In Louisiana the closed season shall be between February 1 and October 31; and
>
> In California the closed season shall continue until September 1, 1918.

Black-breasted and golden plover and greater and lesser yellowlegs.—The closed seasons on black-breasted and golden plover and greater and lesser yellowlegs in Zone two shall be as follows:

In Delaware, Maryland, District of Columbia, and Virginia the closed season shall be between December 1 and August 15 next following;

In South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas the closed season shall be between February 1 and October 31 next following;

In North Carolina, Tennessee, Arkansas, Oklahoma, New Mexico, and Arizona the closed season shall be between December 16 and August 31 next following; and

In California the closed season shall continue until September 1, 1918.

Jacksnipe.—The closed seasons on jacksnipe or Wilson snipe in Zone two shall be as follows:

In Delaware, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana the closed season shall be between February 1 and October 31 next following; and

In Oklahoma, Texas, New Mexico, Arizona, and California the closed season shall be between February 1 and October 15 next following.

Woodcock.—The closed season on woodcock in Zone two shall be between January 1 and October 31 next following.

REGULATION 9.—HEARINGS.

Persons recommending changes in the regulations or desiring to submit evidence in person or by attorney as to the necessity for such changes should make application to the Secretary of Agriculture. Hearings will be arranged and due notice thereof given by publication or otherwise as may be deemed appropriate. Persons recommending changes should be prepared to show the necessity for such action and to submit evidence other than that based on reasons of personal convenience or a desire to kill game during a longer open season.

REPEAL.

Except in respect to offenses theretofore committed, on and after the date of the approval by the President of the foregoing regulations such regulations shall supersede the regulations for the protection of migratory birds approved and proclaimed October first, one thousand nine hundred and thirteen (38 Stat., 1960), as amended by regulations for the protection of migratory birds approved and proclaimed August thirty-first, one thousand nine hundred and fourteen (38 Stat., 2024), as further amended by regulations for the protection of migratory birds approved and proclaimed October first, one thousand nine hundred and fourteen (38 Stat., 2032).

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the city of Washington this twenty-first day of August, in the year of our Lord one thousand nine hundred and sixteen, and of the independence of the United States the one hundred and forty-first.

[SEAL.]

WOODROW WILSON.

By the President:
ROBERT LANSING,
Secretary of State.

CONVENTION

BETWEEN THE UNITED STATES AND GREAT BRITAIN FOR THE PROTECTION OF MIGRATORY BIRDS IN THE UNITED STATES AND CANADA.[1]

Whereas many species of birds in the course of their annual migrations traverse certain parts of the United States and the Dominion of Canada; and

Whereas many of these species are of great value as a source of food or in destroying insects which are injurious to forests and forage plants on the public domain, as well as to agricultural crops, in both the United States and Canada, but are nevertheless in danger of extermination through lack of adequate protection during the nesting season or while on their way to and from their breeding grounds;

The United States of America and His Majesty the King of the United Kingdom of Great Britain and Ireland and of the British dominions beyond the seas, Emperor of India, being desirous of saving from indiscriminate slaughter and of insuring the preservation of such migratory birds as are either useful to man or are harmless, have resolved to adopt some uniform system of protection which shall effectively accomplish such objects, and to the end of concluding a convention for this purpose have appointed as their respective plenipotentiaries:

The President of the United States of America, Robert Lansing, Secretary of State of the United States; and

His Britannic Majesty, the Right Honorable Sir Cecil Arthur Spring Rice, G. C. V. O., K. C. M. G., etc., His Majesty's ambassador extraordinary and plenipotentiary at Washington;

Who, after having communicated to each other their respective full powers, which were found to be in due and proper form, have agreed to and adopted the following articles:

Article I.

The High Contracting Powers declare that the migratory birds included in the terms of this Convention shall be as follows:

1. Migratory Game Birds:

(*a*) Anatidæ or waterfowl, including brant, wild ducks, geese, and swans.

(*b*) Gruidæ or cranes, including little brown, sandhill, and whooping cranes.

(*c*) Rallidæ or rails, including coots, gallinules, and sora, and other rails.

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[1] This treaty, signed on Aug. 16 and ratified Aug. 29, 1916, will be effective on exchange of ratifications. (See Art. IX.)

The Constitution of the United States contains the following provision in regard to treaties:

"This Constitution, and the laws of the United States which shall be made in pursuance thereof; and all treaties made, or which shall be made, under the authority of the United States shall be the supreme law of the land; and the judges in every State shall be bound thereby, anything in the constitution or laws of any State to the contrary notwithstanding." (Art. VI, par. 2.)

(*d*) Limicolæ or shorebirds, including avocets, curlew, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs.

(*e*) Columbidæ or pigeons, including doves and wild pigeons.

2. Migratory Insectivorous Birds: Bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, humming birds, kinglets, martins, meadowlarks, nighthawks or bull bats, nut-hatches, orioles, robins, shrikes, swallows, swifts, tanagers, titmice, thrushes, vireos, warblers, wax-wings, whippoorwills, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects.

3. Other Migratory Nongame Birds: Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

ARTICLE II.

The High Contracting Powers agree that, as an effective means of preserving migratory birds there shall be established the following close seasons during which no hunting shall be done except for scientific or propagating purposes under permits issued by proper authorities.

1. The close season on migratory game birds shall be between March 10 and September 1, except that the close season on the Limicolæ or shorebirds in the maritime Provinces of Canada and in those States of the United States bordering on the Atlantic Ocean, which are situated wholly or in part north of Chesapeake Bay shall be between February 1 and August 15, and that Indians may take at any time scoters for food but not for sale. The season for hunting shall be further restricted to such period not exceeding three and one-half months as the High Contracting Powers may severally deem appropriate and define by law or regulation.

2. The close season on migratory insectivorous birds shall continue throughout the year.

3. The close season on other migratory nongame birds shall continue throughout the year, except that Eskimos and Indians may take at any season auks, auklets, guillemots, murres, and puffins, and their eggs, for food and their skins for clothing, but the birds and eggs so taken shall not be sold or offered for sale.

ARTICLE III.

The High Contracting Powers agree that during the period of ten years next following the going into effect of this Convention there shall be a continuous close season on the following migratory game birds, to wit:

Band-tailed pigeons; little brown, sandhill, and whooping cranes, swans, curlew and all shorebirds (except the black-breasted and golden plover, Wilson or jack snipe, woodcock, and the greater and lesser yellowlegs); provided that during such ten years the close seasons on cranes, swans, and curlew in the Province of British Columbia shall be made by the proper authorities of that Province within the general dates and limitations elsewhere prescribed in this Convention for the respective groups to which these birds belong.

ARTICLE IV.

The High Contracting Powers agree that special protection shall be given the wood duck and the eider duck either (1) by a close season extending over a period of at least five years, or (2) by the establishment of refuges, or (3) by such other regulations as may be deemed appropriate.

ARTICLE V.

The taking of nests or eggs of migratory game or insectivorous or nongame birds shall be prohibited, except for scientific or propagating purposes, under such laws or regulations as the High Contracting Powers may severally deem appropriate.

ARTICLE VI.

The High Contracting Powers agree that the shipment or export of migratory birds or their eggs from any State or Province, during the continuance of the close season in such State or Province, shall be prohibited except for scientific or propagating purposes, and the international traffic in any birds or eggs at such time captured, killed, taken, or shipped at any time contrary to the laws of the State or Province in which the same were captured, killed, taken, or shipped shall be likewise prohibited. Every package containing migratory birds or any parts thereof or any eggs of migratory birds transported, or offered for transportation from the Dominion of Canada into the United States or from the United States into the Dominion of Canada, shall have the name and address of the shipper and an accurate statement of the contents clearly marked on the outside of such package.

ARTICLE VII.

Permits to kill any of the above-named birds which, under extraordinary conditions, may become seriously injurious to the agricultural or other interests in any particular community, may be issued by the proper authorities of the High Contracting Powers under suitable regulations prescribed therefor by them respectively, but such permits shall lapse, or may be cancelled, at any time when, in the opinion of said authorities, the particular exigency has passed, and no birds killed under this article shall be shipped, sold, or offered for sale.

ARTICLE VIII.

The High Contracting Powers agree themselves to take, or propose to their respective appropriate law-making bodies, the necessary measures for insuring the execution of the present Convention.

ARTICLE IX.

The present Convention shall be ratified by the President of the United States of America, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty. The ratifications shall be exchanged at Washington as soon as possible and the Convention shall take effect on the date of the exchange of the ratifications. It shall remain in force for fifteen years, and in the event of neither of the High Contracting Powers having given notification, twelve months before the expiration of said period of fifteen years, of its intention of terminating its operation, the Convention shall continue to remain in force for one year and so on from year to year.

In faith whereof, the respective Plenipotentiaries have signed the present Convention in duplicate and have hereunto affixed their seals.

Done at Washington this sixteenth day of August, one thousand nine hundred and sixteen.

[SEAL.] ROBERT LANSING.
[SEAL.] CECIL SPRING RICE.

OPEN SEASONS.

All the general open seasons for game[1] prescribed by the various States and by the Provinces of Canada are here brought together in one table. For the sake of simplicity a uniform method is used in both the arrangement of species and statement of seasons. In each case deer and other big game are first considered; then rabbits and squirrels; then upland game birds, such as quail, grouse, pheasants, turkeys, and doves; then shore birds; and finally waterfowl, such as ducks, geese, and brant, but always combining the species which have the same open season. In stating the seasons the plan of the Vermont law, to include the first date but not the last, has been followed consistently.[2] The Vermont scheme has the advantage of showing readily both the open and close seasons, since either may be obtained by reversing the dates of the other.

In some States certain days of the week constitute close seasons throughout the time in which killing is permitted. Hunting on Sunday is prohibited in all of the States and Provinces east of the one hundred and fifth meridian except Illinois, Louisiana, Michigan, Texas, Wisconsin, and Quebec. Mondays constitute a close season for waterfowl in Ohio, and locally in Maryland and North Carolina; and other week days for wild fowl in several favorite ducking grounds in Delaware, Maryland, Virginia, and North Carolina. Hunting is prohibited on election day in Allegany, Baltimore, Cecil, Charles, Frederick, and Harford Counties, Md.; and when snow is on the ground in New Jersey, Delaware, Virginia, and Maryland. The county laws of North Carolina, which are too numerous to be included satisfactorily, are not incorporated in the following table, which otherwise may be regarded as a practically complete résumé of the regulations now in force. The difficulty of securing absolute accuracy in a table of this kind is very great, and the absence in the laws of many States of express legislation as to the inclusion or exclusion of the date upon which seasons open and close makes exactness almost an impossibility.

In the following table the seasons on migratory birds are in accordance with State laws and the amended Federal regulations.

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[1] For open seasons on fur-bearing animals see Farmers' Bulletin No. 783, 1916.

[2] For discussion of this question see Circular No. 43 of the Biological Survey, U. S. Department of Agriculture, 1904, entitled "Definitions of the open and close seasons for game."

Species like the band-tailed pigeon, cranes, curlew, godwit, upland plover, wood duck, swan, and the smaller shore birds, which are protected until 1918 under the regulations, are not included unless protected for a term of years under the State law.

OPEN SEASONS FOR GAME IN THE UNITED STATES AND CANADA, 1916.

[The open seasons include the first date, but not the last. To find the close seasons, *reverse the dates.* Seasons which apply only to special counties are placed to the left of the column containing those for the State in general. Species on which the season is closed for a term of years or an indefinite period are grouped at the end of each State under the term "No open season."]

		Open seasons.
Alabama:		
Male deer (does protected all the year)		Nov. 1–Jan. 1.
Squirrel (black, gray, or fox)		May 15–June 15. Aug. 1–Jan. 1.
Quail or partridge		Nov. 1–Mar. 1.
Ruffed grouse (pheasant), imported pheasant, or other introduced game birds		Nov. 15–Dec. 15.
Wild turkey gobblers (hens protected all the year)		Dec. 1–Apr. 1.
Dove		Aug. 1–Mar. 1.
Woodcock		Nov. 1–Jan. 1.
Plover, snipe, yellowlegs, coot, mud hen, duck, goose, brant		Nov. 1–Feb. 1.
Rail		Sept. 1–Dec. 1.
No open season: Elk (1925); curlew, sandpiper, other shore birds, wood duck, swan (1918).		
Alaska:[1]		
North of latitude 62°—		
Moose (females and yearlings protected all the year), caribou, sheep		Aug. 1–Dec. 11.
South of latitude 62°—		
Deer with horns 3 inches long (see exception)		Aug. 15–Nov. 1.
Exception: Deer on Duke, Gravina, Kodiak, Long, Kruzof, San Juan, Suemez, and Zarembo Islands	Aug. 1, 1918.	
Mountain goat in southeast Alaska and Kenai Peninsula	Aug. 1, 1918.	
Moose (females and yearlings protected all the year), caribou, sheep (see exception)		Aug. 20–Jan. 1.
Exception: Moose, south Lynn Canal; caribou on the Kenai Peninsula; sheep, Kenai Peninsula, east of long. 150°	Aug. 20, 1918.	
Brown bear		Oct. 1–July 2.
Throughout Territory—		
Grouse, ptarmigan, shore birds, waterfowl		Sept. 1–Mar. 2.
Arizona:		
Deer (male)		Oct. 1–Dec. 16.
Quail (except bobwhite)		Oct. 15–Feb. 2.
Wild turkey		Oct. 1–Dec. 16.
Dove and white wings		June 1–Feb. 2.
Plover		Sept. 1–Dec. 16.
Yellowlegs		Oct. 15–Dec. 16.
Rail		Oct. 15–Dec. 1.
Snipe, coot, gallinule, duck, goose, brant		Oct. 16–Feb. 1.
No open season: Female deer, spotted fawn, elk, antelope, sheep, goat, bobwhite, grouse, pheasant.		
Arkansas:		
Deer, bear, wild turkey (gobblers also, Apr. 15–June 1)		Nov. 11–Jan. 11.
Quail or partridge		Dec. 1–Feb. 1.
Prairie chicken, pinnated grouse		Nov. 1–Dec. 1.
Woodcock		Nov. 1–Jan. 1.
Black-breasted and golden plover, yellowlegs		Sept. 1–Dec. 16.
Rail		Sept. 1–Dec. 1.
Snipe, coot, gallinule, duck, goose		Nov. 1–Feb. 1.
No open season: Dove.		

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[1] *Alaska:* Game animals or birds may be killed at any time for food or clothing by native Indians or Eskimos, or by miners or explorers in need of food, but game so killed can not be shipped or sold.

Open seasons for game—Continued.

	Open seasons.
California: [1]	
Male deer (except spike bucks), in districts 1 and 23	Aug. 15–Oct. 15.
In districts 2 and 3	Aug. 1–Sept. 15.
In district 4	Sept. 1–Oct. 1.
Cottontail and bush rabbit, valley and desert quail	Oct. 15–Jan. 1.
Tree squirrel (except in Mendocino County, unprotected)	Sept. 1–Jan. 2.
Mountain quail, grouse, districts 1 and 23	Sept. 1–Dec. 1.
In districts 2, 3, and 4	Oct. 15–Jan. 1.
Sage hen, dove	Sept. 1–Dec. 1.
Wilson or jacksnipe, coot, gallinule, duck (except wood duck), goose, brant	Oct. 16–Feb. 1.
No open seasons: Does, spike buck, fawn, elk, antelope, sheep, pheasant, introduced quail or partridge, turkey, swan, rail, band-tailed pigeon, wood duck; plover, yellowlegs (1918).	
Colorado:	
Rabbit, hare (except jack rabbit, unprotected)	Oct. 1–Mar. 1.
Prairie chicken, mountain and willow grouse	Aug. 15–Oct. 11.
Sage chicken	Aug. 1–Sept. 2.
Dove	Aug. 15–Sept. 1.
Plover, yellowlegs	Sept. 1–Dec. 16.
Snipe, coot, gallinule, duck, goose, brant	Sept. 7–Dec. 21.
Rail	Sept. 1–Dec. 1.
No open season: Deer, male (1918); elk, antelope, sheep, quail (bobwhite, crested), pheasant, black game, capercailzie (1924); doe, partridge, ptarmigan, wild turkey, wild pigeon.	
Connecticut:	
Hare, rabbit (except Belgian or German hare, unprotected)	Oct. 8–Jan. 1.[2]
Gray squirrel, quail, ruffed grouse, pheasant (imported), Hungarian partridge, woodcock	Oct. 8–Nov. 24.
Black-breasted and golden plover, yellowlegs	Sept. 1–Dec. 1.
Wilson or English snipe, mud hen, gallinule	Oct. 1–Jan. 1.
Rail	Sept. 12–Dec. 1.
Duck, goose, brant	Oct. 1–Jan. 16.
No open season: Deer [3] (June 1, 1917), dove, wood duck (1919), swan (1918).	
Delaware:	
Rabbit, hare, quail, partridge, woodcock	Nov. 15–Jan. 1.
Squirrel (fox, black, gray)	Sept. 1–Oct. 16.
Dove (except in Newcastle County, no open season)	Aug. 1–Jan. 1.
Ortolan or rail, reedbird	Sept. 1–Nov. 1.
Black-breasted and golden plover, yellowlegs	Aug. 16–Dec. 1.
Wilson or jack snipe, coot, gallinule, duck, goose, brant	Nov. 1–Feb. 1.
No open season: Hungarian partridge or pheasant; wood duck (1918).	
District of Columbia: [4]	
Deer meat (sale or possession)	Sept. 1–Jan. 1.
Rabbit (except English rabbit, Belgian hare), squirrel	Nov. 1–Feb. 1.
Quail or partridge	Nov. 1–Mar. 15.
Ruffed grouse or pheasant (except English or other imported pheasants raised in inclosures, sale or possession unrestricted), wild turkey	Nov. 1–Dec. 26.
Prairie chicken (pinnated grouse)	Sept. 1–Mar. 15.

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[1] *California:* Seasons fixed by boards of county supervisors are omitted. Of the 30 fish and game districts created under the act of 1915, only 5 are properly hunting districts, 6 are game refuges, and the others are fish districts. The hunting districts are as follows: District No. 1: Del Norte, Siskiyou, Modoc, Humboldt, Trinity, Shasta, Lassen, Tehama, Plumas, Butte, Yuba, Sutter, Sacramento, Amador, Alpine, Calaveras, Tuolumne, Mono, Inyo, Madera, Mariposa, Tulare, Kings, and the parts of Sierra, Nevada, Placer, Eldorado, not in the Tahoe or Truckee River Basin, and the eastern parts of San Joaquin, Stanislaus, Merced, Fresno, and Kern Counties. District No. 2: Mendocino, Glenn, Colusa, Lake, Yolo, Napa, Sonoma, Marin, and Solano Counties. District No. 3: Contra Costa, San Francisco, San Mateo, Alameda, Santa Cruz, Santa Clara, San Benito, Monterey, San Luis Obispo, and the western parts of San Joaquin, Stanislaus, Merced, Fresno, and Kern Counties. District No. 4: Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, Orange, San Diego, and Imperial Counties. District No. 23: Comprises the drainage area of Lake Tahoe and the Truckee River.

[2] *Connecticut:* Between Nov. 24 and Jan. 1, hunting is permitted with dog and ferret only.

[3] Deer may be killed with shotgun on a person's own land at any time if reported to commissioners within 24 hours.

[4] *District of Columbia:* Hunting prohibited in the District, by act of June 30, 1906, except on the marshes of the Eastern Branch above the Anacostia Bridge and on the Virginia side of the Potomac, but in this area no birds may be shot within 200 yards of any bridge or dwelling.

Open seasons for game—Continued.

	Open seasons.
District of Columbia—Continued.	
Marsh blackbird	Sept. 1–Dec. 16.
Woodcock	Nov. 1–Jan. 1.
Plover, yellowlegs, rail or ortolan	Sept. 1–Dec. 1.
Reedbird	Sept. 1–Nov. 1.
Snipe, coot, gallinule, duck, goose, brant	Nov. 1–Feb. 1.
No open season: Dove; wood duck (1918).	
Florida:	
Deer, quail (bobwhite partridge), wild turkey, dove	Nov. 20–Mar. 10.
Squirrel	Oct. 1–Mar. 1.
Ruffed grouse, imported pheasants	Nov. 20–Dec. 20.
Woodcock	Nov. 1–Jan. 1.
Plover, snipe, yellowlegs, coot, gallinule, duck, goose, brant	Nov. 20–Feb. 1.
Rail	Nov. 20–Dec. 1.
Georgia:	
Deer (male)	Oct. 1–Dec. 1.
Cat squirrel	Oct. 1–Mar. 1.
Opossum	Oct. 1–Mar. 1.
Quail, partridge, wild turkey	Nov. 20–Mar. 1.
Dove	Aug. 1–Sept. 1. Nov. 20–Mar. 1.
Plover, yellowlegs	Nov. 20–Feb. 1.
Snipe	Dec. 1–Feb. 1.
Reedbird	Sept. 1–Nov. 1.
Woodcock	Dec. 1–Jan. 1.
Rail	Sept. 1–Dec. 1.
Coot, gallinule, duck (except wood duck), goose, brant	Nov. 1–Feb. 1.
No open season: Fox squirrel (Jan. 1, 1918).	
Idaho:[1]	
Deer (male) (see exception), goat	Sept. 1–Dec. 1.
Exception: Deer in Bonner, Clearwater, Idaho, Kootenai, Latah, Nez Perce, and Shoshone Counties	Sept. 20–Dec. 20.
Elk (male) in Bingham, Bonnevile, Fremont, and Teton Counties only (no open season in rest of State)	Sept. 1–Jan. 1.
Quail (except in Lemhi County, Mar. 5, 1919)	Nov. 1–Dec. 1.
Partridge, pheasant, grouse (except north of Salmon River, Sept. 1–Dec. 1)	Aug. 15–Dec. 1.
Turtle dove (except in Fremont County, Aug. 15–Dec. 1), sage hen	July 15–Dec. 1.
Plover, snipe, yellowlegs, coot, duck, goose, brant	Sept. 7–Dec. 21.
Rail	Sept. 1–Dec. 1.
No open season: Moose, antelope, caribou, sheep, buffalo, doe, fawn, cow and yearling elk, prairie chicken, pinnated grouse, imported pheasants, swan (1918).	
Illinois:	
Rabbit	Aug. 31–Feb. 1.
Squirrel (gray, red, fox, black)	Aug. 1–Feb. 1.
Quail	Nov. 11–Dec. 10.
Prairie chicken	Oct. 1–Oct. 16.
Imported pheasants (cocks)	Oct. 1–Oct. 6.
Mourning dove	Aug. 15–Sept. 1.
Plover, yellowlegs	Sept. 1–Dec. 16.
Snipe, coot, duck, goose, brant	Sept. 16–Dec. 16.
No open season: Deer, wild turkey, female imported pheasants, partridges, sand grouse (1925); ruffed grouse, partridge, blue, mountain, and valley quail, Hungarian partridge, capercailzie, heath hen, black grouse, woodcock, rail, swan, smaller shore birds (1920), wood duck (1918).	
Indiana:	
Rabbit	Apr. 1–Jan. 10.
Squirrel	July 1–Nov. 1.
Quail, ruffed grouse	Nov. 10–Dec. 21.
Prairie chicken	Oct. 15–Nov. 1.
Woodcock	Oct. 1–Dec. 1.
Black-breasted and golden plover, yellowlegs	Sept. 1–Dec. 16.
Wilson or jacksnipe	Sept. 16–Dec. 20.
Coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
Rail	Sept. 1–Dec. 1.
No open season: Deer, Hungarian partridge, imported pheasant, wild turkey, dove, wood duck.	

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[1] *Idaho:* In Bannock, Bear Lake, Cassia, Franklin, Oneida, Power, and Twin Falls Counties hunting big game, quail, and Mongolian pheasants is prohibited until Mar. 11, 1920.

Open seasons for game—Continued.

	Open seasons.
Iowa:	
Squirrel (gray, timber, or fox)	Sept. 1–Jan. 1.
Quail, ruffed grouse or pheasant, wild turkey	Nov. 1–Dec. 15.
Prairie chicken (pinnated grouse), rail	Sept. 1–Dec. 1.
Woodcock	Oct. 1–Dec. 1.
Black-breasted and golden plover, yellowlegs	Sept. 1–Dec. 16.
Wilson or jacksnipe, coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
No open season: Deer, elk, pheasants (English, Mongolian, Chinese, ringneck), Hungarian partridge (Oct. 1, 1917); turtle dove, wood duck.	
Kansas:	
Fox squirrel (red, gray, and black, no open season)	Sept. 1–Jan. 1.
Woodcock	Oct. 1–Dec. 1.
Plover, yellowlegs	Sept. 1–Dec. 16.
Snipe, coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
Rail	Sept. 1–Dec. 1.
No open season: Deer, antelope (1921), quail, prairie chicken, pheasants (English, Mongolian, or Chinese), Hungarian partridge (1918), grouse.	
Kentucky:	
Rabbit [1]	Nov. 15–Jan. 1.
Squirrel (black or fox)	July 1–Dec. 16.
Quail	Nov. 15–Jan. 2.
Dove	Sept. 1–Oct. 16.
Black-breasted and golden plover, yellowlegs	Sept. 1–Dec. 16.
Wilson or jacksnipe, coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
Rail	Sept. 1–Dec. 1.
No open season: Deer, elk (1921); native and imported pheasants, Hungarian partridge, wild turkey (1920); woodcock.	
Louisiana:	
Deer (see exception)	Sept. 15–Jan. 6.[2]
Exception: South of Vernon, Rapides, Avoyelles, and Concordia Parishes and Mississippi State line ... Oct. 1–Jan. 21.	
Bear	Nov. 1–Feb. 1.
Raccoon, opossum	Nov. 1–Feb. 16.
Squirrel	Oct. 1–Feb. 16.
Dove, Florida duck (black mallard)	Nov. 1–Feb. 16.
Quail, wild turkey gobblers	Nov. 15–Mar. 1.
Woodcock	Nov. 15–Jan. 1.
Black-breasted and golden plover, snipe, yellowlegs, rail, coot, gallinule, duck, goose, brant	Nov. 1–Feb. 1.
No open season: Fawns, elk (1919); prairie chicken, imported pheasant, wild turkey hen, upland plover, papabotte, killdeer (1920).	
Maine: [3]	
Deer (see exception)	Oct. 1–Dec. 16.
Exception: In Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties ... Nov. 1–Dec. 1.	
Hare, rabbit	Oct. 1–Apr. 1.
Gray squirrel	Sept. 1–Nov. 1.
Ruffed grouse, partridge (see exception)	Sept. 15–Nov. 15.
Exception: Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties ... Oct. 1–Dec. 1.	
Woodcock (see exception)	Oct. 1–Nov. 15.
Exception: Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties ... Oct. 1–Dec. 1.	
Plover, yellowlegs	Aug. 16–Dec. 1.
Snipe, coot, gallinule	Sept. 16–Dec. 1.

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[1] *Kentucky:* Rabbits may be taken with dogs or snares at any time for own use on own land, but not for sale or barter.

[2] *Louisiana:* Deer season fixed by conservation commissioner.

[3] *Maine:* All hunting is prohibited on Kineo Point, Piscataquis County; on Back Bay above Grand Trunk Railroad bridge, Cumberland County; and until 1919 in town of Perkins, southern point of Swan Island.

Open seasons for game—Continued.

Maine—Continued.	*Open seasons.*
Rail	Sept. 1–Dec. 1.
Duck, goose, brant	Sept. 16–Dec. 16.
No open season: Deer, Cross, and Scotch Islands (1919), Mount Desert Island; bull moose (1919); cow and calf moose; caribou (1917); quail, Hungarian partridge, pheasant, black game, capercailzie, cock of the woods, dove, wood duck, and the smaller shore birds.	
Maryland:	
Rabbit	Nov. 10–Dec. 25.
Squirrel (see exceptions)	Aug. 25–Oct. 2. Nov. 10–Dec. 25.
Exceptions: In Cecil and Frederick Counties	Aug. 25–Dec. 25.
In Anne Arundel, Calvert, Charles, Dorchester, Prince George, St. Mary, and Talbot Counties	Nov. 10–Dec. 25.
Quail, ruffed grouse, wild turkey, imported pheasant, woodcock (see exceptions)	Nov. 10–Dec. 25.
Exceptions: Quail in Frederick (1921); ruffed grouse, ring-necked pheasant, wild turkey in Harford (no open season); ruffed grouse, introduced pheasant in Wicomico (1921).	
Plover, yellowlegs	Aug. 16–Dec. 1.
Reedbird, sora (water rail or ortolan)	Sept. 1–Nov. 1.
Snipe, coot, gallinule, duck, goose, brant	Nov. 1–Feb. 1.[1]
No open season: Deer, elk (1922); dove.	
Massachusetts:	
Deer (third Monday in November to the following Saturday, inclusive)	Nov. 20–25, 1916.
Hare or rabbit	Oct. 12–Mar. 1.
Gray squirrel	Oct. 12–Nov. 13.
Quail (except in Essex County, Oct. 12, 1919), ruffed grouse or partridge, woodcock	Oct. 12–Nov. 13.
Introduced pheasants in Barnstable, Berkshire, Essex, Hampden, Middlesex, Norfolk, and Worcester Counties only	Oct. 12–Nov. 13.
Black-breasted and golden plover, yellowlegs	Aug. 16–Dec. 1.
Rail	Sept. 1–Dec. 1.
Snipe, gallinule, quark (mudhen), duck, (except wood duck), goose, brant	Sept. 16–Jan. 1.
No open season: Moose, dove, wild or passenger pigeon, prairie chicken, Hungarian partridge, pheasants (English, golden, Mongolian),[2] killdeer, piping plover, wood duck, swan, heath hen, Bartramian sandpiper (upland plover).	
Michigan:	
Deer (see exceptions)	Nov. 10–Dec. 1.
Exceptions: Deer in red coat, fawn in spotted coat; all deer on Bois Blanc Island (1918); in Berrien, Calhoun, Genesee, Ingham, Jackson, Kalamazoo, Oakland, and St. Clair Counties (1920).	
Rabbit	Oct. 1–Mar. 2.
Ruffed grouse (partridge), woodcock	Oct. 1–Dec. 1.
Plover, yellowlegs	Sept. 1–Dec. 16.
Snipe, coot, gallinule, duck, goose, brant	Sept. 16–Dec. 16.
Rail	Sept. 1–Dec. 1.
No open season: Elk, moose, caribou, European partridge, dove, swan; squirrel, quail, imported pheasants, black game, capercailzie, hazel grouse, Canada or spruce grouse, prairie chicken, wild turkey, smaller shorebirds (1920); wood duck (1918).	
Minnesota:	
Deer, bull moose	Nov. 10–Nov. 30.
Quail, partridge, ruffed grouse (pheasant)	Oct. 1–Dec. 1.
Sharp-tailed or white-breasted grouse, prairie chicken (pinnated grouse), black-breasted plover, Wilson or jacksnipe	Sept. 7–Nov. 7.
Coot, gallinule, duck, goose, brant	Sept. 7–Dec. 1.
Rail	Sept. 1–Dec. 1.
No open season: Elk, cow moose, caribou, fawn, imported pheasants; dove, woodcock, upland and golden plover, wood duck (1918).	

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[1] *Maryland:* Wild fowl shooting permitted: On the Susquehanna Flats north of a line extending from Turkey Point Lighthouse, Cecil County, and half a mile north of Spesutia Island to Oakington, Harford County, on Mondays, Wednesdays, and Fridays, Nov. 1–Jan. 1, and Mondays, Wednesdays, Fridays, and Saturdays, Jan. 1–Feb. 1; in Harford County only before 2 p. m.; in Anne Arundel County, on Magothy River on Tuesdays, Thursdays, and Saturdays; on Rhode and West Rivers on Mondays, Wednesdays, and Fridays; on Severn River on Mondays, Wednesdays, and Saturdays; in Cecil County, on Bohemia, Elk, and Sassafras Rivers on Mondays, Wednesdays, Fridays, and Saturdays; in Dorchester County, on Choptank River on Tuesdays, Thursdays, and Saturdays; in Kent County, on Chester River above Cliff City and Spaniard Point on Mondays, Fridays, and Saturdays.

[2] *Massachusetts:* Commissioners may open season on pheasants.

Open seasons for game—Continued.

	Open seasons.
Mississippi: [1]	
Deer	Dec. 1–Jan. 2.
Bear	Dec. 15–Feb. 1.
Squirrel	Oct. 15–Jan. 1.
Quail or partridge	Nov. 15–Feb. 15.
Wild turkey gobblers	Nov. 15–May 1.
Dove	July 1–Oct. 1.
Woodcock	Nov. 1–Jan. 1.
Plover, chorook, grosbec, Wilson or jacksnipe, yellowlegs, coot, poule d'eau, gallinule, duck, goose, brant	Nov. 1–Feb. 1.
Rail (mud hen)	Sept. 1–Dec. 1.
Cedar bird	Sept. 1–Mar. 1.
No open season: Turkey hens (1921).	
Missouri:	
Deer (buck), wild turkey	Nov. 1–Jan. 1.
Squirrel (gray, black, fox)	June 1–Jan. 1.
Quail (bobwhite, partridge)	Nov. 10–Jan. 1.
Dove	Aug. 1–Nov. 11.
Plover, yellowlegs	Sept. 1–Dec. 16.
Snipe, coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
Rail	Sept. 15–Dec. 1.
No open season: Does, fawns under 1 year of age, ruffed grouse (pheasant), prairie chicken (pinnated grouse), woodcock, imported pheasants, other introduced game birds.	
Montana:	
Deer	Oct. 1–Dec. 15.
Elk in Sweetgrass, Stillwater, Park, Gallatin, Madison, Teton, Flathead; Beaverhead east of Oregon Short Line and parts of Missoula and Powell Counties	Oct. 1–Dec. 15.
Pheasant, partridge, prairie chicken, sage hen, fool hen, grouse (see exception)	Sept. 15–Oct. 16.
Exception: In Custer, Dawson, Richland, Sheridan, Valley, Phillips, Rosebud, Big Horn, Fallon, and Prairie Counties	Sept. 1–Oct. 1.
Black-breasted and golden plover, Wilson or jacksnipe, yellowlegs, coot, duck, goose, brant	Sept. 7–Dec. 21.
Rail	Sept. 1–Dec. 1.
No open season: Elk (except as above), sheep, goat (1918); moose, caribou, antelope, bison or buffalo, quail, imported pheasant, dove.	
Nebraska:	
Squirrel (gray, red, fox, timber)	Oct. 1–Dec. 1.
Quail	Nov. 1–Nov. 16.
Dove	July 15–Sept. 1.
Prairie chicken, sage chicken, grouse, rail	Sept. 1–Dec. 1.
Wilson or jacksnipe, coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
Yellowlegs	Sept. 1–Dec. 16.
No open season: Deer, elk, antelope, partridge, pheasant, ptarmigan, imported game birds, wild pigeon, wild turkey, curlew, crane, swan.	
Nevada: [2]	
Deer (except fawns, no open season), antelope	Sept. 15–Oct. 16.
Grouse, mountain and valley quail, prairie chicken	Sept. 15–Jan. 1.
Sage hen	July 15–Feb. 16.
Woodcock	Nov. 1–Jan. 1.
Black-breasted and golden plover, yellowlegs	Sept. 15–Dec. 16.
Rail	Sept. 1–Dec. 1.
Wilson or jacksnipe, duck	Oct. 1–Jan. 1.
Coot, gallinule, goose, brant	Oct. 1–Jan. 16.
No open season: Pheasants (1920).	
New Hampshire: [3]	
Deer in Coos County	Oct. 15–Dec. 16.
Deer in Carroll and Grafton Counties	Nov. 1–Dec. 16.
Deer in rest of State	Dec. 1–Dec. 16.
Hare, rabbit	Oct. 1–Mar. 1.
Quail, partridge, ruffed grouse, woodcock	Oct. 1–Dec. 1.
Black-breasted and golden plover, yellowlegs	Aug. 16–Dec. 1.
Wilson or jacksnipe	Sept. 16–Dec. 1.
Coot, gallinule, duck, goose, brant	Sept. 16–Dec. 16.
Rail	Sept. 1–Dec. 1.
No open season: Elk, moose, caribou, dove, pheasant, European partridge, killdeer, upland plover, Bartramian sandpiper, wood duck; gray squirrel (1919).	

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[1] *Mississippi:* Local regulations of boards of supervisors also in force.

[2] *Nevada:* County commissioners may change dates of close seasons on deer, antelope, and sage hens (without altering length), and may shorten open seasons on other game.

[3] *New Hampshire:* Governor and council may suspend open season in time of excessive drought.

Open seasons for game—Continued.

	Open seasons.
New Jersey:	
Deer [1] (male—with horns visible above the hair)	Oct. 11, 18, 25, and Nov. 1.
Rabbit, squirrel, quail, ruffed grouse (partridge), prairie chicken, Hungarian partridge, English or ringneck pheasant cocks	Nov. 10–Dec. 16.
Woodcock	Oct. 10–Dec. 1.
Reedbird	Sept. 1–Nov. 1.
Black-breasted and golden plover, yellowlegs	Aug. 16–Dec. 1.
Wilson or jacksnipe	Oct. 1–Jan. 1.
Marsh hen, rail	Sept. 1–Dec. 1.
Coot, gallinule, duck, goose, brant	Oct. 1–Jan. 16.
No open season: Does and fawns; female English or ringneck pheasants, wild turkey (1919); wood duck (1918); dove, wild pigeon, upland plover, swan.	
New Mexico:	
Deer (with horns):	
North of latitude 35°	Oct. 16–Nov. 6.
South of latitude 35°	Oct. 25–Nov. 26.
Squirrel (tassel-eared gray)	June 1–Dec. 1.
Quail (except bobwhite)	Oct. 25–Jan. 1.
Grouse	Sept. 16–Nov. 26.
Wild turkey:	
North of latitude 35°	Nov. 1–Jan. 1.
South of latitude 35°	Oct. 25–Nov. 26.
Turtle dove	Aug. 16–Oct. 1.
Plover, yellowlegs	Sept. 1–Dec. 16.
Snipe, coot, gallinule, duck, goose, brant	Oct. 16–Feb. 1.
Rail	Sept. 1–Dec. 1.
No open season: Does, Sonoran deer, elk, sheep, goat, antelope, buffalo, bobwhite quail, pheasant, ptarmigan, wild pigeon, swan; prairie chicken, sage hen (1920).	
New York: [2]	
Deer, with horns not less than 3 inches long, in Adirondack region [3]	Oct. 1–Nov. 16.
Exception: In Ulster County and towns of Neversink, Cochecton, Tusten, Highland, Lumberland, Forestburg, Bethel, and all of towns of Mamakating and Thompson south of Newburgh and Cochecton turnpike in Sullivan County, and Deer Park in Orange County ... Nov. 1–Nov. 16.	
Varying hare, rabbit [4]	Oct. 1–Feb. 1.
Squirrel, black, gray, or fox (no open season in corporate limits of city or village)	Oct. 1–Nov. 16.
Grouse, partridge [4]	Oct. 1–Dec. 1.
Pheasants, males only	Oct. 19, Oct. 26. Nov. 2, Nov. 9.[4]
Woodcock	Oct. 1–Nov. 16.
Black-breasted and golden plover, snipe, yellowlegs, rail, coot, gallinule	Sept. 16–Dec. 1.
Waterfowl (except wood duck and swan)	Sept. 16–Jan. 1.
No open season: Elk, moose, caribou, antelope, female deer and fawns, Hungarian or European gray-legged partridge, dove, wood duck, swan; quail (1918).	
New York—Long Island:	
Varying hare, rabbit (cottontail), squirrel (black, gray, fox), quail, pheasants (males only), grouse	Nov. 1–Jan. 1.
Woodcock	Oct. 15–Dec. 1.
Black-breasted and golden plover, yellowlegs	Aug. 16–Dec. 1.
Jacksnipe, rail, coot, mud hen, gallinule	Sept. 16–Dec. 1.
Waterfowl (except wood duck and swan)	Oct. 1–Jan. 11.
No open season: Deer, dove, wood duck, swan.	

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[1] *New Jersey:* Not applicable to possession of imported deer properly tagged.

[2] *New York:* When date of open or close season falls on Sunday, season opens or closes on the preceding Saturday.

[3] The Adirondack region comprises the counties of Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Jefferson, Lewis, Oneida, Oswego, Saratoga, St. Lawrence, Warren, and Washington.

[4] Seasons on upland game shortened by order of conservation department as follows: Cottontail rabbit in Richmond County, Oct. 1–Nov. 15 and Jan. 1–Feb. 1, and in Rockland County Oct. 1–Nov. 1 and Jan. 1–Feb. 1; squirrels (black, gray, fox) and ruffed grouse are protected in Genesee County, and varying hares in Cattaraugus County until Oct. 1, 1918. Pheasants protected until Oct. 1, 1917, in the counties of Allegany, Cattaraugus, Chautauqua, Clinton, Delaware, and Tioga, and until Oct. 1, 1918, in Erie, Essex, Herkimer, Lewis, Montgomery, Oneida, Otsego, St. Lawrence, Sullivan, and Warren Counties.

Open seasons for game—Continued.

		Open seasons.
North Carolina: [1]		
Deer		Oct. 1–Feb. 1.
Quail, wild turkey, dove		Nov. 1–Mar. 1.
Woodcock		Nov. 1.–Jan. 1.
Black-breasted and golden plover, yellowlegs		Sept. 1–Dec. 16.
Wilson or jacksnipe, coot, gallinule, duck, goose, brant		Nov. 1–Feb. 1.
Rail		Sept. 1–Dec. 1.
No open season: Wood duck, swan (1918).		
North Dakota:		
Prairie chicken (pinnated grouse), sharp-tailed (white-breasted) grouse, golden plover, snipe		Sept. 7–Nov. 2.
Woodcock		Oct. 1–Nov. 2.
Coot, gallinule, duck, goose, brant		Sept. 7–Dec. 1.
Rail		Sept. 1–Dec. 1.
No open season: Deer (1920), elk, moose, antelope, quail, partridge, English pheasant, Chinese ringneck pheasant, Hungarian partridge, dove, swan, crane.		
Ohio:		
Rabbit		Nov. 1–Jan. 2.
Squirrel		Sept. 15–Oct. 21.
Raccoon		Nov. 1–Mar. 2.
Woodcock		Oct. 1–Dec. 1.
Plover, yellowlegs		Sept. 1–Dec. 16.
Snipe, duck, goose, brant		Sept. 16–Dec. 16.[2]
Rail, coot, gallinule		Sept. 1–Dec. 1.
No open season: Quail, ruffed grouse, introduced pheasant, Hungarian or gray partridge, dove (Nov. 15, 1917); wood duck, swan (1918).		
Oklahoma: [3]		
Deer (male—with horns)		Nov. 1–Dec. 1.
Quail, Mexican (blue)		Nov. 30–Jan. 1.
Wild turkey (additional season for gobblers, Mar. 15–Apr. 15)		Nov. 15–Jan. 1.
Woodcock		Nov. 1–Jan. 1.
Black-breasted and golden plover, yellowlegs		Sept. 1–Dec. 16.
Wilson or jacksnipe, coot, gallinule, duck, goose, brant		Oct. 16–Feb. 1.
Rail		Sept. 1–Dec. 1.
No open season: Does, prairie chicken, wild pigeon, imported pheasant, dove, crane, long-billed curlew, wood duck; antelope (1918).		
Oregon:		
District No. 1,[4] *west of Cascades:*		
Deer (male—with horns)		Aug. 15–Nov. 1.
Silver gray squirrel, dove		Sept. 1–Nov. 1.
Quail in Coos, Curry, Jackson, and Josephine Counties only		Oct. 1–Nov. 1.
Grouse, Chinese pheasant (see exceptions)		Oct. 1–Nov. 1.
Exceptions: Chinese pheasant in Jackson County	Oct. 1–11.	
In Coos, Curry, and Josephine Counties	No open season.	
Snipe, coot, duck, goose (see exceptions)		Nov. 1–Jan. 16.
Exceptions: In Coos (goose and snipe only), Clatsop, Columbia, Multnomah, and Tillamook Counties	Oct. 1–Jan. 1.	
Duck in Coos County	Oct. 1–Jan. 16.	
Black-breasted and golden plover, yellowlegs (see exception)		Nov. 1–Dec. 16.
Exception: In Clatsop, Columbia, Coos, Multnomah, and Tillamook Counties	Oct. 1–Dec. 16.	
Rail (see exception)		Nov. 1–Dec. 1.
Exception: In Clatsop, Columbia, Coos, Multnomah, and Tillamook Counties	Oct. 1–Dec. 1.	
Brant		Oct. 1–Jan. 16.
No open season: Does and spotted fawn, moose, elk, antelope, caribou, sheep, goat, quail (except as above), pheasant (silver, golden, Reeves, and English), Hungarian partridge, bobwhite, prairie chicken, Franklin grouse, fool hen, wild turkey, shore birds (except as above), wild pigeon, wood duck, swan.		

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[1] *North Carolina:* For county seasons see special poster of the Biological Survey, U. S. Department of Agriculture.

[2] *Ohio:* Sundays and Mondays are close seasons for ducks and other waterfowl.

[3] *Oklahoma:* No open season for deer, bear, and wild turkeys in Blaine, Caddo, Comanche, Kiowa, and Major Counties.

[4] *Oregon:* District No. 1, west of Cascades, includes Benton, Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties. District No. 2, east of Cascades, includes all other counties in the State.

Open seasons for game—Continued.

		Open seasons.
Oregon—Continued.		
District No. 2,[1] *east of Cascades* (open season same as in District No. 1, except as follows):		
Chinese pheasant in Union County and quail in Klamath County	Oct. 1–Oct. 11.	
Ruffed grouse, native pheasant, blue or sooty grouse		Aug. 15–Nov. 1.
Prairie chicken in Sherman, Union, and Wasco Counties only	Oct. 1–Oct. 16.	
Sage hen		July 15–Sept. 1.
Black-breasted and golden plover, yellowlegs		Oct. 1–Dec. 16.
Snipe, coot, duck, goose[2]		Oct. 1–Jan. 16.
Rail		Oct. 1–Dec. 1.
No open season: Silver gray squirrel, imported pheasants.		
Pennsylvania:		
Deer—male with horns 2 inches above the hair		Dec. 1–Dec. 16.
Bear		Oct. 15–Dec. 16.
Hare, rabbit		Nov. 1–Dec. 1.
Squirrel (gray, black, fox), quail, ruffed grouse, ringneck pheasant, wild turkey, Hungarian partridge, woodcock, blackbird		Oct. 15–Dec. 1.
Reedbird		Sept. 1–Nov. 1.
Black-breasted and golden plover, yellowlegs		Sept. 1–Dec. 16.
Coot, mud hen, gallinule		Oct. 1–Jan. 1.
Wilson or jacksnipe, wild waterfowl—duck, goose, brant, loon, grebe		Oct. 1–Jan. 16.
Rail		Sept. 1–Dec. 1.
No open season: Elk (1921); upland or grass plover, wood duck (1918); doe, dove, killdeer, fawn, plover.		
Rhode Island:		
Gray squirrel, hare, rabbit, quail or bobwhite, ruffed grouse or partridge		Nov. 1–Jan. 1.
Woodcock		Nov. 1–Dec. 1.
Plover, yellowlegs		Aug. 16–Dec. 1.
Snipe		Oct. 1–Dec. 1.
Coot, gallinule, duck, goose, brant		Oct. 1–Jan. 16.
Rail		Sept. 1–Dec. 1.
No open season: Deer,[3] dove, pheasant, Hungarian partridge (1920); wood duck, swan, smaller shore birds (1918).		
South Carolina:		
Deer (see exceptions)		Sept. 1–Jan. 1.
Exceptions: In Berkeley and Dorchester Counties	Aug. 1–Feb. 1.	
In Barnwell, Florence, and Marion Counties	Aug. 1–Jan. 1.	
In Colleton County	Sept. 1–Feb. 1.	
In Orangeburg, Richland, and Sumter Counties	No open season.	
Squirrel in Chesterfield and York Counties	Oct. 1–Jan. 1.	
Quail (partridge), wild turkey (see exceptions)		Nov. 15–Mar. 15.
Exceptions: In Abbeville, Chester, Lancaster, and York Counties	Dec. 1–Feb. 1.	
In Fairfield County	Dec. 1–Mar. 1.	
Quail in Chesterfield County	Nov. 15–Mar. 1.	
Quail in Marlboro County	Nov. 15–Feb. 15.	
Quail in Union County	Dec. 1–Mar. 1.	
Wild turkey in Orangeburg County	No open season.	
Dove (see exception)		Aug. 15–Mar. 1.
Exception: In Kershaw County	Aug. 15–Mar. 15.	
Woodcock		Nov. 1–Jan. 1.
Grackle		Oct. 1–Mar. 1.
Black-breasted and golden plover, Wilson or jacksnipe, yellowlegs, coot, gallinule, duck, goose, brant		Nov. 1–Feb. 1.
Reedbird		Sept. 1–Nov. 1.
Rail		Sept. 1–Dec. 1.
South Dakota:		
Deer		Nov. 1–Dec. 1.
Partridge, grouse, prairie chicken, golden plover, snipe, yellowlegs		Sept. 10–Oct. 10.
Woodcock		Oct. 1–Oct. 10.
Rail		Sept. 1–Dec. 1.
Coot, gallinule		Sept. 7–Dec. 21.
Duck, goose, brant		Sept. 10–Dec. 21.
No open season: Fawns, elk, antelope, mountain sheep, quail, dove, upland plover, imported pheasants.		

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[1] *Oregon:* District No. 1, west of Cascades, includes Benton, Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties. District No. 2, east of Cascades, includes all other counties in the State.

[2] Unlawful to kill geese at any time on islands or sand bars in the Columbia east of the Cascades or on Deschutes and John Day Rivers south to junction with White River and Thirtymile Creek, respectively.

[3] *Rhode Island:* Deer injuring crops may be killed at any time by the owner or occupant of the premises under written permit from secretary of state.

Open seasons for game—Continued.

	Open seasons.
Tennessee:	
Squirrel	June 1–Jan. 1.
Quail or partridge (see exceptions), wild turkey (additional season for gobblers, Apr. 1–25)	Nov. 15–Jan. 1.
Exceptions: Quail, in White (1918), Chester, Fayette, Hardeman, and Haywood Counties	Dec. 15–Mar. 1.
Grouse, pheasant (except imported species)	Nov. 1–Mar. 1.
Dove	Aug. 15–Jan. 1.
Woodcock	Nov. 1–Jan. 1.
Black-breasted and golden plover, yellowlegs	Oct. 1–Dec. 16.
Wilson or jacksnipe, coot, mud hen, gallinule	Nov. 1–Dec. 16.
Rail	Sept. 1–Dec. 1.
Duck, goose, brant	Nov. 1–Jan. 16.
No open season: Deer (1917), ring-necked and Mongolian pheasants, robin, meadowlark.	
Texas:	
Deer (male), antelope, mountain sheep	Nov. 1–Jan. 1.
Quail or partridge	Dec. 1–Feb. 1.
Prairie chicken, pinnated grouse, introduced pheasant	Nov. 1–Feb. 1.
Wild turkey	Dec. 1–Apr. 1.
Dove	Sept. 1–Mar. 1.
Woodcock	Nov. 1–Jan. 1.
Black-breasted and golden plover, yellowlegs	Nov. 1–Feb. 1.
Wilson or jacksnipe, coot, gallinule, duck, goose, brant	Oct. 16–Feb. 1.
Rail	Sept. 1–Dec. 1.
No open season: Does, spotted fawns.	
Utah:	
Deer (male—with horns visible above the head) (see exception)	Oct. 15–Nov. 1.
Exception: Nonresident not permitted to kill deer.	
Quail in Carbon, Davis, Salt Lake, San Pete, Sevier, Uintah, Utah, and Weber Counties	Oct. 1–Nov. 1.
Quail in Garfield, Kane, and Washington Counties	Sept. 1–Feb. 1.
Quail in Iron County	Oct. 1–Dec. 1.
Sage hen (see exception), blue and willow grouse	Sept. 1–Sept. 16.
Exception: Sage hen in Rich and Uintah Counties	Aug. 15–Sept. 16.
Dove	Aug. 15–Sept. 1.
Snipe, duck, goose (see exception)	Oct. 1–Jan. 1.
Exception: In Grand, Kane, San Juan, Uintah, and Washington Counties	Oct. 1–Jan. 16.
Coot, gallinule	Oct. 1–Jan. 16.
Rail	Sept. 1–Dec. 1.
No open season: Does, fawns, elk, antelope, sheep, quail (except as above), partridge, prairie chicken, pheasants (Chinese, English, Mongolian), robin, shore birds (except snipe), wood duck, swan.	
Vermont:[1]	
Deer (male)	Nov. 15–Dec. 6.
Hare, rabbit	Sept. 15–Mar. 1.
Gray squirrel, quail, ruffed grouse (partridge)	Sept. 15–Dec. 1.
Woodcock	Oct. 1–Dec. 1.
Black-breasted and golden plover, yellowlegs	Sept. 1–Dec. 1.
English snipe	Sept. 16–Dec. 1.
Coot, gallinule, duck, goose, brant	Sept. 16–Jan. 1.
No open season: Elk (1923), moose, caribou, fawns, pheasants, European partridge, dove, upland plover, rail, wood duck, swan.	
Virginia:[2]	
Deer (see exceptions)	Sept. 1–Dec. 1.
Exceptions: In Chesterfield, Mecklenburg, Prince George, and Surry	Oct. 1–Jan. 1.
In Brunswick and Greenesville	Oct. 1–Feb. 1.
No open season: In Augusta and Cumberland (1919); Bath, Buckingham, and Highland (1921); Shenandoah (1920).	

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[1] *Vermont:* The governor is authorized to suspend open seasons in time of drought and fix another open season for deer in such event.

[2] *Virginia:* Boards of supervisors may shorten the open seasons in their counties and make other restrictions not repugnant to law, "and may include in such protection other game not specifically mentioned in this section." (Code 1904, sec. 2070a, as amended in 1906.) These changes are not included in this table.

Open seasons for game—Continued.

	Open seasons.
Virginia—Continued.[1]	
Rabbit[2]	Nov. 1–Feb. 1.
Squirrel[3] in Brunswick, Caroline, Charles City, Greenesville, James City, New Kent, Spotsylvania, Stafford, and York Counties	Nov. 1–Feb. 1.
In Isle of Wight and Southampton	Sept. 1–Jan. 15.
In Shenandoah	Aug. 15–Oct. 1.
In Warren	Nov. 15–Jan. 1.
Quail or partridge, pheasant or grouse, wild turkey (see exception)	Nov. 1–Feb. 14.
Exception: West of the Blue Ridge	Nov. 1–Jan. 1.
Dove in Brunswick and Greenesville Counties	Aug. 15–Jan. 15.
Woodcock, coot, mudhen, gallinule	Nov. 1–Jan. 1.
Black-breasted and golden plover, yellowlegs	Aug. 16–Dec. 1.
Rail	Sept. 1–Dec. 1.
Reedbird	Sept. 1–Nov. 1.
Wilson or jacksnipe, winter water fowl[4] (except waterfowl in Brunswick and Greenesville Counties, Nov. 1–Jan. 1)	Nov. 1–Feb. 1.
No open season: Quail, pheasant, dove in Lee County (1918); pheasant, Middlesex County (1919); ring-necked pheasant, Shenandoah (1920).	
Washington:	
West of Cascades:	
Deer, goat	Sept. 15–Nov. 1.
Quail, ruffed grouse, native pheasant, Chinese pheasant, blue grouse, ptarmigan.	Sept. 15–Nov. 1.
English, Mongolian, and Reeves pheasants (except in Mason and Thurston Counties no open season)	Oct. 1–Oct. 16.
East of Cascades:	
Deer, goat, caribou	Oct. 1–Nov. 15.
Ruffed grouse, native pheasant (except in Yakima County, no open season), blue grouse (see exception)	Sept. 1–Nov. 16.
Exception: In Asotin (in precincts of Clarkston, South Clarkston, and West Clarkston, no open season), Columbia, Garfield, and Walla Walla Counties	Aug. 15–Oct. 2.
Quail in counties of Asotin (in precincts of Clarkston, South Clarkston, and West Clarkston, no open season), Columbia, Garfield, and Walla Walla	Oct. 1–Oct. 11.
Prairie chicken in same counties	Sept. 15–Nov. 2.
Sharp-tailed grouse in Adams, Asotin, Columbia, Ferry, Garfield, Lincoln, Okanogan, Walla Walla, and Whitman Counties	Sept. 15–Nov. 2.
In Douglas County	Sept. 1–Nov. 2.
Sharp-tailed grouse, Hungarian partridge, Chinese pheasant in Kittitas County	Oct. 1–Oct. 11.
Sage hens in Benton, Spokane, and Yakima Counties	Oct. 15–Nov. 2.
In Kittitas County	Oct. 1–Oct. 11.
Bobwhite quail, Hungarian partridge in Spokane County	Oct. 1–Nov. 16.
Chinese pheasant in Benton, Spokane, and Yakima Counties	Oct. 1–Oct. 16.
Black-breasted and golden plover, Wilson or jacksnipe, yellowlegs	Oct. 1–Dec. 16.
Coot, duck, goose, brant	Oct. 1–Jan. 16.[5]
Rail	Oct. 1–Dec. 1.
No open season: Moose, elk (1925); fawns, mountain sheep, squirrels (gray, black, fox), wild turkey, dove, and introduced birds (except as above).	
West Virginia:	
Deer (with horns more than 4 inches long—no open season for other deer), ruffed grouse (pheasant), wild turkey	Oct. 15–Dec. 1.
Rabbit (except on own land)	Oct. 15–Jan. 1.
Squirrel (black, gray, red, fox)	Sept. 15–Dec. 1.
Quail (Virginia partridge)	Nov. 1–Dec. 1.
Woodcock	Oct. 1–Dec. 1.
Black-breasted and golden plover	Sept. 1–Dec. 16.

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[1] *Virginia:* Boards of supervisors may shorten the open seasons in their counties and make other restrictions not repugnant to law, "and may include in such protection other game not specifically mentioned in this section." (Code 1904, sec. 2070a, as amended in 1906.) These changes are not included in this table.

[2] Residents of the State may kill rabbits on their own lands at any time.

[3] Residents of the State may kill squirrels on their own lands at any time.

[4] Wild fowl may not be hunted on Wednesdays, Saturdays, and Sundays on Back Bay, Princess Anne County.

[5] *Washington:* No open season on waterfowl on Columbia or Snake Rivers or within ¼ mile of their shores in counties of Benton, Columbia, Douglas, Franklin, Garfield, Grant, Kittitas, Klickitat, Walla Walla, Whitman, and Yakima.

Open seasons for game—Continued.

	Open seasons.
West Virginia—Continued.	
Jacksnipe or Wilson snipe, yellowlegs	Oct. 15–Dec. 16.
Rail (ortolan)	Sept. 1–Dec. 1.
Coot, gallinule, duck (except wood duck), goose, brant	Oct. 1–Jan. 1.
No open season: Elk (1923); imported pheasants, capercailzie, and other introduced foreign game birds, dove, wood duck.	
Wisconsin:	
Deer (male) in Pierce, Dunn, Eau Claire, Trempealeau, Jackson, Juneau, Sauk, Marathon, Langlade, Oconto, Door, and all counties north (except Polk)	Nov. 11–Dec. 1.
No open season: Deer in rest of State.	
Rabbit, in Eau Claire, Pierce, Portage, Richland, Waupaca, and Waushara Counties	Sept. 10–Feb. 1.
In Dane, Dunn, Green, Green Lake, Juneau, La Crosse, Marinette, Outagamie, Rock, Sheboygan, Trempealeau, Walworth, and Wood Counties	Oct. 10–Feb. 1.
In Dodge, Jefferson, Manitowoc, Ozaukee, Washington, and Waukesha Counties	Nov. 1–Jan. 1.
Squirrel (gray, fox, black—see exceptions)	Oct. 10–Feb. 1.
Exceptions: Eau Claire, Portage, Richland, Vernon, Waupaca, and Waushara Counties	Sept. 10–Feb. 1.
In Dodge and Jefferson Counties	Nov. 1–Jan. 1.
In Kenosha, Ozaukee, Pierce, Racine, Washington, and Waukesha Counties	No open season.
Partridge or ruffed grouse, spruce hen (see exception)	Sept. 7–Nov.1.
Exception: In Vernon and Chippewa Counties	Sept. 7–Dec. 1.
Prairie chicken, grouse: In Adams, Ashland, Barron, Bayfield, Brown, Burnett, Buffalo, Clark, Columbia, Crawford, Dodge, Douglas, Dunn, Eau Claire, Florence, Fond du Lac, Grant, Green, Green Lake, Iowa, Jackson, Juneau, Kewaunee, Lafayette, Marathon, Marinette, Marquette, Monroe, Oconto, Outagamie, Pepin, Pierce, Polk, Portage, Richland, Rock, Rusk, St. Croix, Sawyer, Shawano, Washburn, Waupaca, Waushara, and Wood Counties	Sept. 7–Oct. 1.
In Waukesha County	Sept. 7–Sept. 16.
In Chippewa and Vernon Counties	Sept. 7–Dec. 1.
In rest of State	Sept. 7, 1919.
Plover, snipe, coot or mud hen, rail, rice hen, duck, goose, brant	Sept. 7–Dec. 1.
No open season: Elk, moose, quail, pheasants (Chinese, English, Monogolian), Hungarian partridge, woodcock, dove, wood duck, swan.	
Wyoming: [1]	
Deer (see exception)	Oct. 1–Nov. 16.
Exception: In Campbell, Crook, Johnson, Niobrara, Sheridan, and Weston Counties	Oct. 15–Nov. 1.
Elk and male sheep in Lincoln, Park, and Fremont Counties (except Bridger National Forest, north of Big Wind River and south of Sweetwater)	Sept. 1–Nov. 16.
Grouse (other than sage grouse)	Sept. 1–Nov. 16.
Sage grouse	Aug. 1–Sept. 2.
Black-breasted and golden plover, Wilson or jacksnipe, yellowlegs, coot, mudhen, duck, goose	Sept. 15–Dec. 16.
Rail	Sept. 1–Dec. 1.
No open season: Elk (except as above); moose,[2] antelope, quail, Mongolian pheasant (1919); dove, swan.	
Alberta: [3]	
Deer (male), bull moose, caribou	Nov. 1–Dec. 15.
Sheep (male), goat	Sept. 1–Oct. 15.
Partridge, Hungarian partridge, grouse, prairie chicken, ptarmigan, pheasant (except English, and Hungarian, no open season)	Oct. 1–Dec. 1.
Plover, curlew, sandpiper, snipe, shore birds, coot, rail, crane, duck,[4] swan	Sept. 1–Jan. 1.
No open season: Elk, wapiti, buffalo, females of deer, moose, sheep, and young of all big game; antelope (1917).	

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[1] *Wyoming:* Hunting permitted in Lincoln County on Fall River rim or crest in cattle districts 1, 3, and 5 in Wyoming National Forest, Oct. 5–Nov. 30.

[2] During the season of 1915–1916 fifty (50) bull moose may be killed under special $100 license; hunter to be accompanied by deputy warden.

[3] *Alberta:* North of latitude 55° any game animal or bird, except elk and buffalo, may be killed at any time if needed for food.

[4] Except white-winged scoters, north of township 50, which may be taken at any time.

Open seasons for game—Continued.

	Open seasons.
British Columbia: [1]	
Deer,[1] (see exception) goat, male caribou [1]	Sept. 1–Dec. 16.
Exception: Deer on Vancouver Island and in Islands Electoral Districts	Sept. 15-Dec. 16.
Bull moose (in Atlin, Caribou, Columbia, Fort George and Omineca Electoral Districts only)	Sept. 1–Dec. 16.
Male sheep (except in North and South Okanogan, Similkameen, and Yale Electoral Districts, no open season)	Sept. 1–Nov. 16.
Ruffed grouse (certain districts), blue grouse, Franklin grouse, ptarmigan	Sept. 15–Dec. 1.
Prairie chicken (certain districts)	Sept. 15–Oct. 16.
Quail in District Municipality of Penticton only	Nov. 1–Nov. 8.
Male pheasants (certain districts)	Oct. 18–Nov. 19.
European partridge (certain districts)	Nov. 17 and 18.
Rail, coot, plover, snipe, curlew, sandpiper, sandhill crane, duck (see exception)	Sept. 1–Feb. 1.
Exception: In Vancouver Island and Islands Electoral Districts Sept 15–Feb. 16.	
Goose	Sept. 1–Apr. 1.
No open season: Buffalo, elk, young of deer and goat, and females and young of mule deer, moose, caribou, and sheep.	
Manitoba: [2]	
Deer, elk or wapiti, moose, caribou or reindeer, antelope or cabri (males)	Nov. 20–Dec. 10.
Partridge, prairie chicken, grouse, ptarmigan	Oct. 1–Oct. 20.
Woodcock, plover, sandpiper, snipe, duck (except wood duck)	Sept. 15–Dec. 1.
No open season: Bison or buffalo, females and young of big game, dove; quail, pheasant, Hungarian partridge, wood duck, swan, curlew, or introduced game bird (1920).	
New Brunswick:	
Deer, moose, caribou (cow and calf [3] moose and caribou, no open season)	Sept. 15–Dec. 1.
Partridge, woodcock, snipe	Sept. 15–Dec. 1.
Teal, wood duck, dusky or black duck (except residents may kill black ducks in Grand Manan Parish, Oct. 1-Mar. 1), goose, brant	Sept. 1–Dec. 2.
Shore or other birds on beaches, islands, or lagoons bordering tidal waters of Northumberland Strait, Gulf of St. Lawrence, and Bay of Chaleur	Aug. 15–Jan. 1.
No open season: Pheasant.	
Newfoundland: [4]	
Caribou (except in a special region near Grand Lake, no open season)	Aug. 1–Oct. 1. Oct. 21–Feb. 1.
Hare, rabbit	Sept. 20–Jan. 1.
Ptarmigan, willow grouse or partridge, plover, curlew, snipe, or "other wild or migratory birds (except wild geese)"	Sept. 20–Jan. 1.
No open season: Elk, moose; capercailzie, black game (1917).	
Nova Scotia:	
Deer, male (except on Cape Breton Island, no open season)	Oct. 21–Nov. 1.
Moose, bulls, (except on Cape Breton Island, 1918)	Sept. 16–Nov. 30.
Caribou, bulls, in Inverness and Victoria Counties only	Sept. 16–Oct. 16.
Hare, rabbit	Oct. 1–Mar. 1.
Partridge or ruffed grouse	Oct. 1–Nov. 1.
Woodcock, Wilson snipe	Sept. 1–Jan. 1.
Ducks (black, Harlequin, golden-eye, and scaup)	Sept. 15–Mar. 1.
Quail, plover, curlew, tattler, shore birds, rail, coot, goose, brant, swan, and teal and ducks other than wood duck (except as above)	Aug. 15–Dec. 1.
No open season: Females and young of deer, moose, and caribou (1918); Canada grouse (spruce partridge), pheasant, wood duck.	

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[1] *British Columbia:* For local exceptions see regulations of lieutenant governor in council. No open season on female mule deer throughout Province or on deer in Queen Charlotte Islands or on white-tailed deer in North and South Okanogan and Similkameen Electoral Districts. No open season on caribou in Charlotte Islands and in Rainbow and Hatchie Mountains of the Prince Rupert Electoral District.

[2] *Manitoba:* Seasons apply south of latitude 53°; north, unlawful to kill any game birds (except ducks and geese) or any big game animals, except for food for personal use.

[3] *New Brunswick:* Under three years of age and with horns having less than three tines 4 inches in length.

[4] *Newfoundland:* Poor settlers may kill any birds except capercailzie and black game at any time for immediate consumption by themselves or their families.

Open seasons for game—Continued.

	Open seasons.
Ontario:[1]	
Deer (except in Dufferin, Grey, Simcoe, and Wellington Counties, to Nov. 1, 1917)	Nov. 1–Nov. 16.[2]
Moose, caribou (bulls only) (cows, and calves under 1 year of age, no open season)	Nov. 1–Dec. 1.[3]
Hare[4]	Oct. 15–Nov. 15. Dec. 23–Jan. 2.
Squirrel (black or gray) (see exceptions)	Nov. 1–Nov. 16.
Exceptions: Haldimand and Halton Counties (1917); Waterloo and York (1918); Elgin, Oxford, and Wentworth (1919).	
Wild turkey	Nov. 1–Nov. 16.
Woodcock	Oct. 15–Nov. 16.
Swan, goose	Sept. 15–May 1.
Plover, snipe, rail, other shore birds, duck and other waterfowl	Sept. 1–Jan. 1.
No open season: Fawns, elk or wapiti, dove, partridge, grouse, prairie fowl (1918); capercailzie (1920); quail, Hungarian partridge, pheasants (1918).	
Prince Edward Island:	
Hare, rabbit	Nov. 1–Feb. 1.
Plover, curlew	Aug. 1–Jan. 1.
Snipe, woodcock	Sept. 1–Jan. 1.
Yellowlegs, shore and other birds along beaches or tidal marshes, duck	Aug. 20–Jan. 1.
Goose	Sept. 15–May 10.
Brant	Apr. 20–Jan. 1.
No open season; Partridge in alternate years, 1916, 1918, etc.	
Quebec:	
Zone 1.[5]	
Deer, bull moose (see exception)	Sept. 1–Jan. 1.
Exception: In Labelle, Ottawa, Pontiac, and Temiscaming Counties .... Oct. 1–Dec. 1.	
Caribou	Sept. 1–Feb. 1.
Hare	Oct. 15–Feb. 1.
Bear	Aug. 20–July 1.
Birch or swamp partridge	Sept. 1–Dec. 15.
White partridge or ptarmigan	Nov. 1–Feb. 1.
Woodcock, plover, curlew, tattler, sandpiper, snipe	Sept. 1–Feb. 1.
Widgeon, teal, duck (except sheldrake), gull, loon	Sept. 1–Mar. 1.[6]
No open season: Cow moose and young deer, moose, and caribou.	
Zone 2. Seasons same as in Zone 1, except as follows:	
Caribou	Sept. 1–Mar. 1.
Hare	Oct. 15–Mar. 1.
Birch or swamp partridge	Sept. 15–Feb. 1.
White partridge or ptarmigan	Nov. 15–Mar. 1.
Saskatchewan:[7]	
Deer, bull elk or wapiti, moose, caribou	Nov. 15–Dec. 15.[8]
Prairie chicken, ptarmigan	Sept. 15–Nov. 1.
Plover, curlew, sandpiper, snipe, shore birds, coot, rail, duck, goose, swan, crane (except whooping crane)	Sept. 15–Jan. 1.
No open season: Antelope, buffalo, and female elk and young of big game under one year of age.[9] English pheasant, whooping crane, partridge (ruffed grouse), sage grouse, Canada or spruce grouse (1918).	

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[1] *Ontario:* Lieutenant governor in council may alter close seasons in region north and west of French River, Lake Nipissing, and Mattawa River and in the vicinity of Rondeau Park, and close for a definite period seasons for any game animal or nonmigratory game bird whose numbers have diminished.

[2] Persons who put deer on their own lands and their licensees may hunt such deer, Oct. 1–Nov. 16.

[3] South of the Canadian Pacific R. R. from Mattawa to Port Arthur, Nov. 1–16.

[4] Hares may be killed during close season by any means other than shooting.

[5] *Quebec:* Zone 1 comprises the whole Province, except that part of the counties of Chicoutimi and Saguenay east and north of the River Saguenay. Zone 2 comprises the excepted part of said counties.

[6] Inhabitants of Zone 2 and of Gaspé County may take these birds for food Aug. 1–June 1.

[7] *Saskatchewan:* Lieutenant governor in council may extend close seasons over current year, within limits, on petition of six game guardians.

[8] Applies north of line between townships 34 and 35; south of said line no open season.

[9] Male moose and elk having horns less than 6 inches in length deemed to be under one year of age.

Open seasons for game—Continued.

	Open seasons.
Northwest Territories:[1]	
Deer, elk or waptiti, moose, caribou, goat, sheep	Dec. 1–Apr. 1.[2]
Musk ox	Oct. 15–Mar. 20.
Partridge, prairie chicken, grouse, pheasant	Sept. 1–Jan. 1.
Duck, goose, swan	Sept. 1–Jan. 15.
Yukon:[3]	
Deer, elk or wapiti, moose, caribou, sheep, goat, musk ox (males only)	Sept. 1–Mar. 1.
Partridge, prairie chicken, grouse, ptarmigan, pheasant	Sept. 1–Mar. 15.
Sandpiper, snipe, crane, duck, goose, swan	Aug. 10–June 1.
No open season: Bison or buffalo and females of other big game.	

SHIPMENT OF GAME.

Shipment is the most important feature of the traffic in game. If permitted without limitation it is a great factor in game destruction. A realization of this fact has induced many of the States to prohibit export of all or certain kinds of game, and in a few instances all transportation even within the State. The subject may be conveniently considered under the following subheads: "Federal laws" and "State laws prohibiting export."

FEDERAL LAWS.

Federal laws affecting the shipment of game comprise the statutes regulating interstate commerce in game and the importation of birds from foreign countries, and those providing for the protection of birds and game on territory under immediate Federal jurisdiction.

They comprise: (1) Sections 241 to 244 of the Criminal Code (35 Stat., 1137), regulating the importation and interstate shipment of game;[4] (2) the tariff act, imposing duties on game and skins and prohibiting the entry of feathers imported from foreign countries; (3) the act regulating the introduction of eggs of game birds; (4) the game law of Alaska; and (5) provisions for protecting birds in national parks,[5] national forests, and other Government reservations. The full text of the Alaskan game law of 1908, with the regulations now in force, is published in circulars of the Biological Survey. Sections 241, 242, 243, and 244 of the Criminal Code of the United States are as follows:

SEC. 241. The importation into the United States, or any Territory or District thereof, of the mongoose, the so-called "flying foxes" or fruit bats, the English sparrow, the starling, and such other birds and animals as the Secretary of Agriculture may from time to time declare to be injurious to the interests of agriculture or horticulture, is hereby prohibited; and all such birds and animals shall, upon arrival at any port of the United States, be destroyed or returned at the expense of the owner. No person shall import into the United States or into any Territory or District thereof any foreign wild animal or bird, except under special permit from the Secretary of Agriculture: *Provided*, That nothing in this section shall restrict the importation of natural-history specimens for museums or scientific collections, or of certain cage birds, such as domesticated canaries, parrots, or such other birds as the Secretary of Agriculture may designate. The Secretary of the Treasury is hereby authorized to make regulations for carrying into effect the provisions of this section.

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[1] *Northwest Territories:* Indians, inhabitants, travelers, explorers, and surveyors in need of food, exempt. Governor in council may alter seasons.

[2] Also July 15–Oct. 1.

[3] *Yukon:* Indians, explorers, surveyors, prospectors, miners, and travelers in need of food are exempt. Commissioner in council may alter seasons.

[4] *Federal laws:* These sections are sections 2, 3, and 4 of the Lacey Act as amended.

[5] The law governing the Yellowstone Park prohibits any person, or any stage, express or railway company from receiving for transportation animals, birds, or fish taken in the park, under a penalty not exceeding $300. (28 Stat., ch. 72, sec. 4.)

SEC. 242. It shall be unlawful for any person to deliver to any common carrier for transportation, or for any common carrier to transport from any State, Territory, or District of the United States, to any other State, Territory, or District thereof, any foreign animals or birds, the importation of which is prohibited, or the dead bodies or parts thereof of any wild animals or birds, where such animals or birds have been killed or shipped in violation of the laws of the State, Territory, or District in which the same were killed, or from which they were shipped: *Provided*, That nothing herein shall prevent the transportation of any dead birds or animals killed during the season when the same may be lawfully captured, and the export of which is not prohibited by law in the State, Territory, or District in which the same are captured or killed: *Provided further*, That nothing herein shall prevent the importation, transportation, or sale of birds or bird plumage manufactured from the feathers of barnyard fowls.

SEC. 243. All packages containing the dead bodies, or the plumage, or parts thereof, of game animals, or game or other wild birds, when shipped in interstate or foreign commerce, shall be plainly and clearly marked, so that the name and address of the shipper, and the nature of the contents, may be readily ascertained on an inspection of the outside of such package.

SEC. 244. For each evasion or violation of any provision of the three sections last preceding, the shipper shall be fined not more than $200; the consignee knowingly receiving such articles so shipped and transported in violation of said sections shall be fined not more than $200; and the carrier knowingly carrying or transporting the same in violation of said sections shall be fined not more than $200.

STATE LAWS PROHIBITING EXPORT.

Since the constitutionality of the Connecticut statute prohibiting export of certain game was established by the supreme court in 1896,[1] nonexport laws have been generally adopted, and at the present time every State prohibits the export of all or certain kinds of game. In most States sportsmen are allowed to carry a limited quantity of game out of the State under special restrictions, and exceptions to the laws prohibiting export are also made in the case of birds and animals intended for propagation or reared in licensed preserves (see pp. 48–50).

Restrictions on shipment from the State have now become so stringent that all the States west of the Mississippi River prohibit export of all game protected by local laws. East of the Mississippi, laws prohibiting the export of all game, or, in some cases, all but one or two unimportant species, are in force in all the States except a few along the coast from Massachusetts to North Carolina.

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[1] Geer *v.* Conn., 161 U. S., 519.

Special attention is called to the following table, which contains a list of the game prohibited from export by each State:

EXPORT OF GAME PROHIBITED.

Alabama: All protected game.

Exceptions: Nonresident licensee may take with him or have carried to him, openly, game lawfully killed by him. State game and fish commissioner may issue $1 permit to any person to capture or export not more than 10 pairs of any one species of game or birds for scientific or propagating purposes.

Alaska: Deer, moose, caribou, sheep, goat, bear, or hides of these animals; wild birds, except eagles, or any parts thereof.

Exceptions: Specimens may be exported under restrictions imposed by the Secretary of Agriculture and trophies of big game under licenses issued by the governor.[1]

Arizona: All protected game.

Exceptions: Deer or wild turkey may be exported under a $2 permit. Game may be exported under permit of warden for scientific or propagating purposes.

Arkansas: All game.

California: All protected game.

Colorado: All protected game.

Exceptions: Game may be exported under permit from game commissioner if permit be attached and packages plainly marked so as to show nature of contents. The following fees are charged for export permits: Elk, $10; deer, $5; sheep, $5; bird, 25 cents—in each case the edible portion alone.

Connecticut: Quail, ruffed grouse, woodcock.

Exception: Nonresident licensee, under permit, may take out in his immediate possession game lawfully killed, when duly tagged, if not for sale.

Delaware: Rabbit, quail, partridge, woodcock. Squirrel, dove, rail, reedbird, goose, brant, for sale.

Exception: Holder of license may export, open to view, 10 rabbits, 10 squirrels, 50 reedbirds, 50 rail, and 20 birds or fowl of any other species a week, lawfully killed by himself, under affidavit that the game is not for sale.

Florida: All protected game.

Exception: Nonresident licensee may carry out game as personal baggage.

Georgia: All protected game from county or State.

Exception: Licensee may take out in personal possession game lawfully killed.

Idaho: All protected game.

Exceptions: Any hunter may export, under hunting license, big game lawfully taken, under a 50-cent permit obtained from game warden or a deputy game warden on a sworn statement to issuing officer that game was not procured contrary to law. Mounted heads and stuffed birds legally secured may be exported.

Illinois: All protected game (except rabbits taken in State).

Exceptions: Nonresident licensee may take from State 50 birds killed by himself, if carried openly for inspection. Holder of certificate may ship birds and game at any time for scientific or propagating purposes.

Indiana: Deer, quail, grouse, prairie chicken, pheasant, wild turkey, woodcock, duck, goose, brant, and other waterfowl.

Exception: Nonresident may take from State 15 birds killed by himself (or 45 if he has hunted for 3 or more days consecutively) if carried openly for inspection together with license.

Iowa: All protected game.

Exception: Nonresident may take from State not more than 25 game birds or animals, if carried openly for inspection, and if hunting license be shown on request.

Kansas: All protected game.

Kentucky: Quail, partridge, grouse, pheasant, wild turkey killed in the State.

Louisiana: All protected game.

Exceptions: A nonresident licensee may carry with him out of the State, under his license, one day's bag limit of game, if not for sale. Game for propagation, head, hide, feet of quadrupeds, and the plumage or skins of birds legally taken when properly marked. Bears may be exported under permit.

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[1] *Alaska.* See p. 57 and also circulars of the Biological Survey, U. S. Department of Agriculture.

Export of game prohibited—Continued.

Maine: All protected game.

Exceptions: A resident of the State may export 1 deer a season if open to view, tagged to show name and address of owner, and accompanied by him, and under shipping license 5 partridges, 10 woodcock, and 10 ducks (fee $5), lawfully killed by himself. A nonresident may export under hunting license tags 2 deer lawfully killed by himself, and may take home 5 partridges, 10 ducks, and 10 woodcock; he may also ship out one pair of game birds a month under a special 50-cent license. Live game may be exported for breeding, scientific, or advertising purposes under permit of the commissioners of inland fisheries and game.

Maryland: All protected game (except waterfowl).

Exception: A licensed hunter may take out under his license an amount equal to one day's bag limit of game.

County provisions are as follows:

Allegany—All protected game (for sale).

Anne Arundel—All protected game, viz: Squirrel, rabbit, quail, partridge, pheasant, woodcock, snipe, plover, duck, goose, brant from county.

Baltimore—Rabbit, squirrel, quail, partridge, pheasant, dove, woodcock from county.

Calvert—Rabbit, partridge, woodcock from county (for sale, barter, or trade).

Carroll—Squirrel, quail, pheasant, dove, woodcock.

Exception: Twelve squirrels, 10 quail, 3 pheasants, 12 doves, 6 woodcock, by guest of landowner or nonresident licensee as personal baggage and not for sale.

Caroline—Rabbit, quail, partridge, woodcock from county.

Cecil—Squirrel, quail, grouse, woodcock, plover from county.

Dorchester—All protected game.

Exception: Twelve quail or partridges, 6 each of squirrels, rabbits, woodcock, and doves may be taken out of the county at one time as personal baggage, if carried openly and not intended for sale.

Frederick—Rabbit (for sale), squirrel, partridge, pheasant, woodcock from county (for sale).

Garrett—Partridge, pheasant, wild turkey, woodcock from State.

Exception: Rabbit, if shipped openly, Nov. 10–Dec. 25. Nonresident may take out game killed under his hunting license.

Harford—Rabbit, squirrel, quail.

Exception: Nonresident licensee may take out 6 rabbits, 1 jack rabbit, 8 squirrels, 10 quail, 5 woodcock, 10 jacksnipe, 50 rail for private use.

Kent—Squirrel, rabbit, and all birds from county (for sale, except under license).

Montgomery—Rabbit, partridge, quail, woodcock from county (for sale).

Exception: Nonresident licensee may take out game lawfully killed.

Queen Anne—Rabbit, partridge, woodcock from any county (for sale).

Somerset—All game, viz: Squirrel, rabbit, quail or partridge, pheasant, dove, woodcock, duck, goose from county.

Talbot—All game.

Exception: Six rabbits, 6 squirrels, 12 quail, 6 doves, 6 woodcock may be taken out if not for sale.

Washington—Deer, squirrel, rabbit, partridge, pheasant, dove, woodcock, turkey from county (for sale).

Wicomico—Quail or partridge from Wicomico and Worcester Counties considered as one territory.

Worcester—Rabbit, quail, woodcock from county.

Massachusetts: Quail, ruffed grouse, woodcock taken in State; other game illegally taken in State.

Exception: Nonresident may take 10 wild fowl or birds of all kinds out of the State and into any other State according similar privileges under his hunting license if open to view and the commission or the district deputy has been notified.

Michigan: All protected game.

Exceptions: (1) Deer may be transported outside the State to reach a point within the State.

(2) Nonresident licensee may take out, as hand baggage, open to view, 1 day's bag limit of birds, and may ship 1 deer when license tag and seal are attached, if permit on back of license coupon is canceled by agent at initial point of billing.

(3) Landowners and members of clubs owning game preserves may take out as hand baggage during open season under a $10 permit from State warden 20 ducks or other migratory birds killed by them on their own premises.

(4) Deerskins and green or mounted buck-deer heads may be exported under permit.

Export of game prohibited—Continued.

Minnesota: All protected game.

Exceptions: Nonresident licensee may ship home in open season under his license coupons 1 deer and 25 birds lawfully taken by himself. Deer and moose hides for tanning and moose heads for mounting may be exported under permit.

Mississippi: All game.

Missouri: All protected game.

Exceptions: Game may be exported under resident or nonresident license if carried openly as baggage or express or in owner's possession and accompanied by him. Export (except of quail) for scientific or propagating purposes allowed under permit.

Montana: All protected game.

Exception: Game lawfully killed may be exported in open season as baggage or express if accompanied by owner and resident's shipping permit (fee 50 cents) from State warden, or under nonresident's hunting license; total shipment under one license not to exceed season's bag limit; packages to be labeled to show contents.

Nebraska: All protected game.

Exception: Nonresident may ship 50 birds out of State under hunting license, but must give common carrier invoice of number and kind of birds, must have details of shipment marked on license, and must accompany the shipment; package to be labeled to show contents.

Nevada: All protected game.

New Hampshire: All protected game.

Exceptions: Game (except ruffed grouse) imported from without the United States or raised in private preserves when tagged and marked to show kind and number, name and address of consignor and consignee, and initial point of billing and destination may be exported unaccompanied by the owner. Game for propagation, the head, hide, feet, or fur of game quadrupeds, and the plumage or skin of game birds legally taken and possessed may be transported without being marked. Nonresident may take with him out of the State, under his hunting license and permit, one day's limit of game birds when properly marked and tagged, and 2 deer under license tags.

New Jersey: Hare, rabbit, squirrel, woodcock, waterfowl, and all other protected game birds.

Exceptions: Nonresident licensee may carry openly from the State 10 rabbits, 50 reed birds, 50 rail, and 15 other game birds a day.

New Mexico: Export of all game taken in the State.

Exceptions: Transportation of game permitted under license coupon or 25 cent permit ($2 in case of export of deer); holder of hunting license, under permit from warden, may export game or birds for scientific or propagating purposes.

New York: Game or birds taken in the State.

Exceptions: Holder of hunting or trapping license may export daily limit of quadrupeds and birds under permit (limited to 6 permits a year). Foreign game or game raised in licensed preserves may be exported in any quantity when duly marked and tagged. Game for propagation and heads and skins of quadrupeds and game birds legally captured may be exported.

North Carolina:[1] Quail, partridge, pheasant, grouse, wild turkey, snipe, shore or beach birds, woodcock, taken in State.

Exceptions: Nonresident may take out of State under his hunting license 50 quail (partridges), 12 grouse, 2 turkeys, and 50 beach birds or snipe in a season. Export permitted under permit of Audubon Society of ruffed grouse, wild turkey, woodcock, snipe, and other shore birds, for propagation.

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[1] *North Carolina:* Export is also prohibited by the following local laws (from county unless otherwise stated): *Deer,* Cherokee, Craven, Hyde (Currituck Twp.); *squirrel,* Craven, Madison, Warren; *quail,* Alamance and Alexander (for sale), nonresident licensee may export 50 at a time; Anson (for sale), Avery, Bladen (for sale), Catawba, Chatham (for sale), Cherokee, Clay, 25 a season may be exported, Craven, Cumberland, Davidson (for sale), Davie (for sale), Duplin (for sale), Guilford (for sale), Harnett, Henderson (bought or sold), Hoke, Iredell, Jackson, Macon (for sale), Madison, Montgomery (for sale), Pitt, Randolph (for sale), Robeson, Rutherford, Sampson (for sale), Stanly, Surry (for sale), Swain (live), Union (for sale), Warren, nonresident licensee may export 25 quail and 1 turkey a season; Wayne, Wilson, nonresident may take out quail killed on own land if not for sale; Yadkin (for sale); *wildfowl,* Avery, Craven (from State), Brunswick (Mar. 10–Nov. 10), Dare (Mar. 10–Nov. 10), New Hanover (Mar. 10–Nov. 10), Robeson, Stanly, Warren (duck); *other game birds,* Bladen (wild turkey, for sale); Cherokee (pheasant, dove, woodcock, snipe, robin); Craven (wild turkey, dove, woodcock, snipe); Cumberland (woodcock, snipe); Madison (pheasant), Montgomery (pheasant, grouse, wild turkey, dove, for sale); Robeson (dove, woodcock, snipe); Stanly (all game birds), Tyrrell (woodcock, snipe, from State, unless killed Nov. 1–Feb. 1); Union (dove, lark, for sale); Warren (wild turkey, except that one a season may be exported by nonresident licensee, woodcock); Wayne (woodcock, snipe).

Export of game prohibited—Continued.

North Dakota: All protected game.

Exceptions: Nonresident licensee may carry with him from State under license tag prairie chickens and sharp-tailed grouse not exceeding 20 in all, and ducks, geese, and brant not exceeding 30 in all, or a total of 50 of all birds combined, if open to view and labeled with his name and address and number of his license. Game may be exported for propagating or scientific purposes.

Ohio: All protected game except rabbits taken in State.

Exception: Nonresident may take with him from State under his hunting license 25 pieces of game.

Oklahoma: All protected game.

Exception: Nonresident licensee may carry to his home two days' bag limit of game birds.

Oregon: All protected game.

Pennsylvania: All protected game taken in the State.

Exception: Nonresident licensee may take with him from the State one day's bag labeled with his name and address and number of his license.

Rhode Island: All protected game birds.

Exception: Nonresident may take with him from the State under his hunting license, open to view, 10 wild fowl or birds the export of which is otherwise prohibited by law.

South Carolina: All game birds or animals taken in the State.

Exception: Licensee may carry openly 2 deer, or 50 partridges, or 12 ruffed grouse, or 4 wild turkeys, or 50 beach birds, or 50 ducks and geese in a season.

South Dakota: All protected game.

Exceptions: One deer under permit and proper tag. Any resident or nonresident may carry out of the State any game bird legally in possession.

Tennessee: All protected game.

Exception: Licensee may take out under his license game killed in State, if carried openly.

Texas: All wild animals, wild birds, and wild fowl found in the State.

Exception: Nonresident licensee may take with him from the State 3 male deer, 75 ducks (if killed in three consecutive days by himself), and one day's bag limit of other birds, under affidavit that his game will not be sold.

Utah: All protected game.

Exception: Nonresident licensee may take one day's bag out of State under permit, if shipment is inspected and marked by a game warden.

Vermont: Deer, gray squirrel, quail, ruffed grouse or partridge, plover, English snipe, woodcock, duck, goose.

Exceptions: Nonresident licensee may export 1 deer and one day's bag of game birds under permit, but must accompany shipment. Resident may send out as a gift one day's limit of game or game birds under special permit from commissioner, but not for sale or barter.

Virginia: All protected game except waterfowl legally killed.

Exceptions: During open season nonresident may, under his hunting license, take with him out of the State, or as baggage on the same conveyance, 1 deer, 50 quail or partridges, 10 pheasants or grouse, 3 wild turkeys, and 25 of each or 100 in all of plover, snipe, sandpipers, willets, tatlers, and curlew, if killed or captured by himself and shipped open to view and plainly labeled with his name and address. Back Bay, Princess Anne County, nonresident licensee permitted to export as personal baggage 25 ducks, geese, or brant he has lawfully killed, but not for sale or barter. Any citizen of State may ship from the State, as a gift and not for sale (which fact must be stated on shipping tag), 1 deer, 18 quail or partridges, 6 pheasants, 3 wild turkeys, if open to view and plainly labeled with names and addresses of donor and donee and number of each kind of bird so shipped.

Shenandoah County: Licensee may take with him from county as personal baggage, open to view, if plainly labeled, 30 quail or partridges, 6 pheasants or grouse, 2 wild turkeys a season, and any citizen may ship the same quantity of game, as a gift, if not for sale.

Washington: All protected game.

West Virginia: Deer, squirrel, quail, ruffed grouse (pheasant), wild turkey, woodcock, plover, snipe, sandpiper, duck, goose, brant, swan.

Wisconsin: All protected game, except rabbit and squirrel.

Exceptions: Nonresident may take out of State with him under his hunting license, in personal possession or as baggage or express, not more than 30 birds of all kinds, provided packages are plainly marked so as to show the names and addresses of shipper and consignee and number of each kind of game. In the case of deer, he must have proper coupons attached. Park boards allowed to ship, under permit of State game warden, live animals and game birds for park purposes.

Export of game prohibited—Continued.

Wyoming: All protected game.

Exceptions: Smithsonian Institution or other well-known scientific institutions may export any game animals or birds under permit of State game commission.

Export of game legally taken permitted upon making affidavit that animals were lawfully killed, paying 25 cents to the justice of the peace of precinct where affiant lives, and attaching the tags issued by him if edible portion is not for sale. A nonresident (or resident when necessary to cross territory of another State to reach his home) may export under his hunting license 20 dead game birds and the carcass, head, antlers, scalp, skin, and teeth of any animal lawfully killed when duly tagged; exchange of game animals and birds for liberation in Wyoming allowed under permit of the State game commission.

Alberta: All protected game.

Exceptions: Minister of agriculture, on receipt of $5 fee, may grant a permit to export for propagating or scientific purposes one pair of each species of big game or game birds. The lieutenant governor in council may grant permits for a greater number. The minister of agriculture may also issue permits for export of game for other purposes at the rate of $5 for each head of big game and $1 per dozen for game birds. The holder of a general nonresident license may take with him out of the Province as trophies heads, skins, and hoofs of big game legally killed by him. Any person may export mounted or branded heads at a fee of $1 for each head. Game reared in captivity may be exported under permit.

British Columbia: All protected game, except under permit of Provincial game warden.

Exceptions: Heads, horns, and skins of big game lawfully killed by the shipper may be shipped under his hunting license and written permission of minister charged with enforcement of act. Any animal or bird, dead or alive, may be exported for scientific, zoological, or Government purposes under permit of Provincial secretary. Live game birds or animals held in captivity under written permission of Provincial game warden may be exported.

Manitoba: All protected game.

Exceptions: Minister of agriculture and immigration may direct chief game guardian to export not more than 12 animals or birds for propagation and may issue permits to export heads and skins of big game animals and any game birds (fee 25 cents), except no permit shall be issued for the export of the entire carcass of any big game or for the export of grouse, ptarmigan, prairie chicken, partridge, ducks, or geese. Nonresident licensee, under license coupons and free permit, may export the carcass of a moose, elk, caribou, or deer killed by himself, and 50 ducks and 50 geese. (No ducks may be exported before Oct. 1.) Taxidermists may export heads of big game under 25-cent permit and proof of lawful killing.

New Brunswick:[1] All protected game.

Exception: Surveyor general may issue special license to export game alive or dead.

Newfoundland: Caribou (antlers, heads, or skins), or partridge, willow or other grouse for sale.

Exceptions: Minister of marine and fisheries may issue licenses to export caribou for breeding or scientific purposes. Nonresident may export 3 stag caribou under hunting license and export permit (fee, 50 cents); resident may export antlers, head, or skin of caribou under export permit; but not, in either case, for sale.

Nova Scotia: All protected game.

Exceptions: Holder of general license may ship out of Province under license tag 1 moose lawfully shot by himself. Mounted heads and dressed skins, and live mammals or birds for propagating or scientific purposes may be exported under permit from Provincial secretary.

Ontario: All wild game animals and birds.

Exceptions: One deer, 1 bull moose, 1 bull caribou, and 100 ducks may be exported under nonresident hunting license if shipping coupon and, if required, affidavit of lawful killing be attached and contents of packages be open to view. Lawfully imported game and deer, moose, elk, or caribou in private ownership may be exported. Minister may issue permit for the export of game, dead or alive, at any time.

Prince Edward Island: All game except geese and brant.

Exception: Nonresident licensee may carry out of Province 12 birds killed by himself.

Quebec: Native deer, moose, caribou, or parts thereof, except under permit from minister of colonization, mines, and fisheries (fee not to exceed $5); also under tags attached to nonresident licenses, not later than 15 days after close of season.

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[1] *New Brunswick:* Except in the case of partridge, the prohibition applies only to common carriers.

Export of game prohibited—Continued.

Saskatchewan: All protected game.

Exceptions: Minister of agriculture may grant permits to export for scientific purposes or propagation in public parks and zoological gardens 1 pair of each species of big game and game birds upon payment of $5, or for propagation a specified number on application of another Province or State. Minister may issue permits to export big game (fee $5 per head), birds (except grouse family) (fee $1 per dozen, limit 5 dozen per season). Nonresident licensee may export under his license and permit big game and 100 game birds legally killed.

Yukon: Protected game may be exported by a nonresident only under a hunting license and a shipping permit issued by the commissioner of the Territory or a game guardian. Export permitted of one head of each of the following kinds of big game: Moose, caribou, sheep, and goat.

Canada also has a general law prohibiting export of deer (except those raised on private preserves), wild turkeys, quail, partridges, prairie fowl, and woodcock, but permitting each nonresident to export two deer[1] in a year at certain ports within 15 days after the close of the open season, under permit of the collector of customs of the port from which export is made. The ports of export are Halifax and Yarmouth, Nova Scotia; Macadam Junction, New Brunswick; Quebec and Montreal, Quebec; Ottawa, Kingston, Niagara Falls, Fort Erie, Windsor, Sault Ste. Marie, and Port Arthur, Ontario; and such others as the minister of customs may designate.

SALE OF GAME.

Legislation restricting the sale of game is passing through a transition stage. Some States prohibit the sale of game throughout the year, others only in close season, and between these extremes may be found all gradations and exceptions, such as restrictions prohibiting sale of game outside the State or for export, and exemptions allowing sale for a few days in the close season. The difficulty of tabulating such regulations is increased by the fact that in addition to the special sale laws, close seasons and provisions regarding possession must be taken into consideration. In consulting the following summary, therefore, it will be necessary to bear in mind three different classes of restrictions: "Sale in close season," "Sale in open season," and "Sale prohibited all the year."

SALE IN CLOSE SEASON.

In general, the sale of game is prohibited during the close season, but a brief additional open period is sometimes provided in order to permit dealers to close out stock on hand at the end of the hunting season. An extension of 15 days for sale of all or certain kinds of game is added to the open season in Alaska, New Jersey, New Brunswick, and Quebec; 30 days in Pennsylvania; 60 days in Yukon; 3 months (for geese and brant) in New Brunswick; and until the following 1st of January in Ontario. In New Hampshire and Vermont the sale of deer meat is permitted for a reasonable time after the close of the season.

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[1] Except from Ontario (see p. 42).

SALE IN OPEN SEASON.

In order to counteract a tendency on the part of market hunters to anticipate the opening of the season, the sale of certain game is sometimes prohibited at the beginning of the open season, as during the first three days in Nova Scotia and Quebec, the first month in British Columbia, and the first six weeks in Louisiana.

SALE PROHIBITED ALL THE YEAR.

Forty-seven States[1] and most of the Provinces of Canada now prohibit the sale of all or certain kinds of game at all seasons. In Alabama, Arizona, Colorado, Florida, Idaho, Iowa, Kansas, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, Texas, and Washington, the sale, and in Delaware, the resale, of all protected game is prohibited; in Illinois, Massachusetts, Michigan, New York, Ohio, Rhode Island, West Virginia, and Wisconsin, except rabbits or a few unimportant species; and in Utah and Manitoba of all big game and upland game. In a few instances prohibitions against the sale of certain game are so general as to afford protection over a considerable area in adjoining States. Thus, ruffed grouse may not be sold in any State or Province along the Canadian border except Quebec. Practically every State in which prairie chickens occur now prohibits their sale or export.

The following statement shows the kind of game the sale of which is prohibited throughout the year. The sale of all other game is so generally prohibited during the close season as to render a detailed enumeration unnecessary; but when an extension of a few days is added to the open season or a special season is provided for either possession or sale, attention is called to this exemption under the heading "Permitted."

SALE OF GAME PROHIBITED THROUGHOUT THE YEAR.

Alabama: All protected game.

Alaska: Heads, hides, and skins of all protected game. Deer until August 1, 1918. Moose and sheep south of latitude 62° and between longitude 141° and a line passing along western outlet of Lake Clark in longitude 155° until August, 1918.

Permitted: Carcasses of all game except deer may be sold during the open season and 15 days thereafter.

Arizona: All protected game.

Arkansas: All "game, wild fowl, or birds whatsoever" (except bear, rabbit, opossum, raccoon, and squirrel).

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[1] Omitting North Carolina, which prohibits sale in only a few counties; and the District of Columbia, which prohibits sale only in close season.

Sale of game prohibited throughout the year—Continued.

California: Deer meat and hides and quail, partridge, pheasant, grouse, sage hen, dove, rail, ibis, and shore birds.

Permitted: Hides of deer lawfully killed when duly tagged under affidavit (fee 25 cents) may be sold August 1–January 1. Cottontail and bush rabbits, coot, gallinule, duck, goose, and black brant may be sold. Domesticated reindeer may be imported and sold under regulations of fish and game commission.

Colorado: All game taken in the State.

Permitted: Imported game of a kind not protected by the laws of the State (under license).

Connecticut: Quail, ruffed grouse, Hungarian partridge, woodcock.

Delaware: All protected game, except that a resident lawfully taking game may sell plover, snipe, and ducks anywhere, and other game in his own county; restaurants buying from such persons may serve game in open season. Imported rabbits may be sold November 15–January 1.

Florida: All protected game.

Georgia: All protected game (except migratory ducks).

Idaho: All protected game.

Illinois: All protected game (except rabbit during open season).

Indiana: Quail, prairie chicken, imported pheasants, Hungarian partridge.

Iowa: All protected game.

Kansas: All protected game.

Kentucky: Quail, partridge, grouse, imported or native pheasant, Hungarian partridge, wild turkey, wherever killed.

Louisiana: All protected game (except snipe, rail, coots, poule d'eau, duck, goose, and brant, which may be sold from December 15 to February 15).

Maine: Deer or moose for export. All protected game birds for any purpose.

Permitted: Deer may be sold by local dealers under license.

Maryland:

Allegany—Deer, squirrel, hare, quail, grouse, introduced pheasant, wild turkey, dove, woodcock.
Anne Arundel—All game (except squirrel, rabbit, and raccoon).
Baltimore—Rabbit, squirrel, quail, ruffed grouse, dove, pheasant, woodcock, for export.
Calvert—Rabbit, quail, woodcock, for export for sale.
Carroll—Squirrel, partridge, pheasant, dove, woodcock.
Cecil—All protected game (except rabbit, rail, reedbird, and duck).
Dorchester—Rabbit, squirrel, quail, partridge, dove, woodcock, wood duck, for export.
Frederick—Rabbit, squirrel, partridge, pheasant, woodcock, snipe, taken in county.
Garrett—Partridge, quail, pheasant, wild turkey, woodcock, for export.
Harford—Rabbit, squirrel, quail (for sale).
Montgomery—Rabbit, quail, partridge, woodcock, for export.
Somerset—Rabbit, quail or partridge, woodcock, dead or alive, for any other purpose than as food within the county or for propagation; or any game for export.
Washington—All game.
Wicomico—Quail or partridge for export (Wicomico and Worcester Counties considered as one territory).
Worcester—Rabbit, quail, woodcock (except to consumer).

Permitted: Baltimore City—Ruffed grouse may be sold October 1 to December 25.

Massachusetts: All game (except hare and rabbit).

Permitted: Deer, moose, caribou, and elk lawfully killed and imported into the State under warden's tag, may be sold under license at any time. Dealers may sell under license unplucked bodies of pheasants, Scotch grouse, European black game, red-legged partridge, Egyptian or migratory quail, European black plover, and mallard ducks imported from without the United States. The above game must be tagged, fee 5 cents a tag. Dealers or persons in the cold-storage business may sell imported quail lawfully obtained during November and December, and may sell at any time hares or rabbits lawfully secured. Live quail and waterfowl for propagation may be sold under permit.

Michigan: All protected game (except rabbit).

Permitted: Deer skins, and green or mounted buck-deer heads lawfully taken and under permit.

Minnesota: All protected game.

Mississippi: All game.

Missouri: All protected game.

Montana: All protected game.

Permitted: Merchant or hotel or restaurant keeper may sell game killed outside the State.

Sale of game prohibited throughout the year—Continued.

Nebraska: All protected game.

Nevada: All protected game.

New Hampshire: Sale for food purposes of the dead bodies of birds belonging to a family any species or subspecies of which is native to and protected by the State.

Permitted: Deer may be sold for food during the open season and may be possessed for a reasonable time thereafter. Hares and rabbits may be sold during the open season.

New Jersey: Deer, squirrel, and game birds (except waterfowl, reedbird, and rail) belonging to a family any species of which is native to and protected by the State.

Permitted: Rabbit, rail, reedbird, and waterfowl during open season and 15 days thereafter; certain imported game, also deer, pheasants, and black and mallard ducks coming from another State may be sold at all times of the year if properly tagged.

New Mexico: All protected game taken in the State.

Permitted: Sale of game imported into State by hotel, restaurant, café, or boarding-house keeper, under a permit good for not more than 30 days.

New York: All game belonging to a family any species or subspecies of which is native to and protected by the State.

Permitted: Varying hares and rabbits legally taken in State during open season (from without State at any time), and unplucked carcasses of pheasants, Scotch grouse, European gray-legged partridge, European black game, European black plover, red-legged partridge, and Egyptian quail, and carcasses of European red deer, fallow deer, roebuck, and reindeer imported from without the United States may be sold under license at any time when duly tagged. Tag fee, 5 cents each.

Licensed breeders in States having laws similar to the game breeding law of New York may import for sale, under $5 license and cost of inspection, domesticated American elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, and mallard and black ducks, when duly tagged.

Head, hide, and feet of quadrupeds legally taken and possessed may be sold at any time.

North Carolina: Restrictions in a number of counties under local laws.[1]

North Dakota: All protected game.

Permitted: Hides, heads, and trophies of big game lawfully taken may be sold at any time.

Ohio: All protected game (except rabbit).

Oklahoma: All protected game.

Permitted: Heads, hides, and horns of big game lawfully killed may be sold.

Oregon: All protected game.

Permitted: Geese killed in Crook, Gilliam, Harney, Morrow, Sherman, Umatilla, and Wasco Counties may be sold during open season when duly tagged. Game birds and animals imported from without the United States, when duly tagged, may be sold September 1 to March 1. Tag fee, 5 cents each.

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[1] *North Carolina:* Sale of game is prohibited by following local laws: *Deer,* Carteret (Newport Township), Craven (to Mar. 5, 1923), Cherokee, Haywood; *squirrel,* Avery (gray or pine squirrel), Craven (to Mar. 5, 1923), Madison, Pender (Rocky Point Township), Transylvania (more than 2 a day), Warren; *quail,* Alamance (to Mar. 8, 1917), Alexander, Anson, Avery, Beaufort, Bladen, Chatham, Cherokee, Clay, Craven (to Mar. 5, 1923), Cumberland, Davidson, Davie, Duplin (outside of county), Guilford, Henderson (for export), Macon, Madison, Montgomery, Moore, Pasquotank, Pender (Rocky Point Township), Pitt, Randolph, Robeson, Rowan, Rutherford, Sampson (for resale or export), Union, Wake, Warren, Wayne, Wilkes, Wilson, Yadkin (outside of county); *duck,* Robeson, Warren; *other game birds,* Avery (lark), Beaufort (pheasant—more than 15 a day), Bladen (wild turkey), Brunswick, New Hanover, and Pender (snipe, woodcock, wood duck), Cherokee (pheasant, dove, robin, woodcock, snipe), Craven (wild turkey, dove, woodcock, snipe), Cumberland (woodcock and snipe), Madison (pheasant), Montgomery (pheasant, turkey), Moore (turkey), Pender (Rocky Point Township—turkey, dove, robin, woodcock), Robeson (dove, robin, woodcock, snipe), Union (dove, lark), Wake (turkey), Warren (turkey, woodcock), Wayne (snipe, woodcock), Wilkes (pheasant), Durham, Orange, and Person prohibit the sale of quail, except by person killing them on his own land; Harnett and Iredell prohibit the sale of quail except during open season by person killing them on his own land; Surry prohibits the sale of quail, except in county by person killing them on his own land or on lands of another under written permission; Vance prohibits the sale of quail, wild turkey, woodcock, and other game birds, except by landowner, tenant, or member of family killing such game on his own land.

Sale of game prohibited throughout the year—Continued.

Pennsylvania: Wild deer, elk, squirrel, rabbit or hare, wild ring-necked pheasant, and Hungarian partridge taken in the State; quail, ruffed grouse (pheasant), wild turkey, and woodcock (wherever taken).

Permitted: Bear, reedbird, black-breasted and golden plover, Wilson or jacksnipe, yellowlegs, coot or mud hen, rail, taken in State, may be sold during open season and 30 days thereafter; waterfowl may be sold September 1 to January 1.

Rhode Island: Quail, ruffed grouse, Hungarian partridge, woodcock, plover, yellowlegs, snipe, curlew, sandpiper, shore, marsh, and beach birds, rail, swan, wood duck.

South Carolina: All game protected by State (except wood duck and grackle).

Permitted: Rice birds, ducks, and game not protected by State law may be sold.

South Dakota: All protected game.

Permitted: Hides, heads, or horns of big game lawfully killed may be sold at any time.

Tennessee: All protected game taken in State.

Texas: All game animals, hides and horns, wild birds, and wild fowl found in the State.

Utah: Deer, elk, antelope, sheep, quail, partridge, grouse, prairie chicken, sage hen, pheasants (Mongolian Chinese, and English), dove.

Permitted: Hides and heads of deer legally killed and tagged, and waterfowl may be sold.

Vermont: All protected game birds or species belonging to any family native to the State.

Permitted: Deer may be sold during the open season and for a "reasonable time thereafter," and hares and rabbits during the open season.

Virginia: Quail or partridge, grouse or pheasant, wild turkey, woodcock.

Clarke County.—Rabbit, squirrel, wild turkey (outside of county).

Frederick, Shenandoah Counties.—Wild turkey (by nonresidents of the State).

Princess Anne County, Back Bay.—Wild fowl (by nonresidents of the State).

Washington: All protected game.

West Virginia: All protected game (except rabbit and rail).

Wisconsin: All protected game (except rabbit and squirrel).

Wyoming: All protected game.

Permitted: Sale of game (except edible portion), on making affidavit that it was legally captured or was taken from animals lawfully killed, paying 25-cent fee to the justice of the peace, and attaching tag issued by him.

Alberta: Grouse, partridge, Hungarian partridge, pheasant, prairie chicken, ptarmigan; other game birds March 1–September 20.

Permitted: The flesh of big game and game birds may be sold under $10 license. Heads of big game before being sold must be stamped by minister of agriculture at fees of $5 for elk, caribou, moose, and sheep, and $2 for deer, antelope, and goat. Game reared in captivity may be sold under permit.

British Columbia: All game, except under regulations of lieutenant governor in council.

Permitted: Moose and caribou (males) may be sold in electorial districts of Atlin, Cariboo, Fort George, and Omineca, October 1–December 16. Sale of big game without head attached and birds without plumage prohibited. Heads of big game killed without and imported into the Province may be sold when branded—fees, moose and elk $5, mountain sheep $4, and caribou $3 per head.

Manitoba: Deer, elk, moose, caribou, antelope (except heads and hides), and all protected game birds.

Permitted: Possession of grouse, prairie chicken, and partridges allowed for ten days, and ducks for three months, after close of hunting season. Venison for private use may be possessed at any time on proof of legal killing.

New Brunswick: Partridge and woodcock until September 15, 1917.

Permitted: Goose and brant during open season and until March 1, and other game during open season and (under license) ten days thereafter. Keepers of hotels, inns, boarding houses, or restaurants may serve game during open season and fifteen days thereafter. Surveyor general may issue $1 licenses to dealer permitting sale of 3 deer, and heads of same to taxidermists, and licenses to deal in hides or skins of game animals with fees of $25 to nonresidents or aliens and $2 to residents.

Newfoundland: Capercailzie, black game.

Permitted: Caribou may be sold from August 1 to January 1; ptarmigan, willow grouse taken in open season may be sold until January 15; other birds may be sold during open season.

Nova Scotia: Deer, caribou, pheasant, blackcock, capercailzie, Canada grouse (spruce partridge), chukar partridge.

Permitted: Moose (meat only) may be sold from September 16 to November 1 under certificate showing lawful killing. Rabbit, December 1 to March 1. Any game bird other than those above mentioned during the open season with the exception of the first three days.

Sale of game prohibited throughout the year—Continued.

Ontario: Waterfowl, quail, partridge, woodcock, snipe, to September 14, 1917.

Permitted: All other native game may be sold during the open season[1] by the person killing it, and by dealers during open seasons and until the following January 1, under license. Imported game may be sold under special regulations and licenses. Game breeders may sell animals for breeding purposes under permit.

Quebec:[2] Birch or swamp partridge until October 1, 1917.

Permitted: All game lawfully taken may be sold from the third day of the open season to the fifteenth day of the close season. Hotels, restaurants, and clubs may serve, under license, all game lawfully taken, except birch or swamp partridge. Live animals, and skins and heads of animals lawfully taken may be sold.

Saskatchewan: Sheep, goat, prairie chicken, grouse, pheasant, ptarmigan, or other member of the Gallinæ.

Yukon:

Permitted: Deer, elk, moose, caribou, bison, musk oxen, sheep, and goats may be sold during the open season and 60 days thereafter.

DISPOSITION OF GAME RAISED IN CAPTIVITY.

About two-thirds of the States now have some special provision regulating possession, sale, or export of game raised in captivity. About half of these States require a license or a permit either for holding the game or for its export. In Arkansas, Missouri, West Virginia, and Wyoming the provisions relate only to big game; in Ohio only to small game or birds. The tagging system under which game may be sold at certain times has been adopted in at least 10 States—California, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Oregon, Pennsylvania, Utah, and Vermont. These tags are sold at a nominal rate, varying from 3 cents in California to 5 cents in New York and Oregon.

Arkansas: Deer raised in captivity may be exported if shipped open to view. Deer raised in preserves may be possessed, sold, and shipped when accompanied by affidavit from raiser that they were raised in captivity.

California: Elk, deer (native or imported), pheasants, partridge, quail, and wild ducks raised in captivity under breeder's license (fee, $25) may be sold at any time for breeding purposes or may be sold for food when properly tagged (fee, 3 cents a tag) during the following seasons: Deer, Aug. 15–Nov. 2; birds, otherwise than by shooting, as follows, quail, Aug. 1–Feb. 2; pheasants and partridges, Oct. 1–Jan. 1; ducks, Oct. 15–Mar. 2; licensed breeder may shoot his surplus cock pheasants and cock partridges during February under permit.

Colorado: Game furnished from a private park or lake of class A may be sold by hotels and restaurants at any time. Game taken from licensed private parks may be sold or shipped at any time if accompanied by an invoice.

Connecticut: Deer, pheasants, and wild fowls raised in licensed preserves (fee, $2) may be sold or transported at any time, when duly tagged under regulations of commissioners of fisheries and game.

Illinois: Deer raised in inclosure for market may be killed and sold Oct. 1–Feb. 1; cock pheasants, Nov. 1–Feb. 1, under permit. Game animals and birds raised in captivity under license (fee, $2) may be sold for propagating or scientific purposes at any time.

Indiana: Game raised in captivity may be killed, sold, or transported at any time.

Iowa: Game raised in captivity under license (fee, $2) may be sold.

Kansas: Game raised in captivity may be transported under permit of warden and $1,000 bond for scientific or propagating purposes.

Kentucky: Game birds and game animals bred in captivity under permit may be sold, transported, or otherwise disposed of at any time when duly tagged.

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[1] *Ontario.*—Seasons depend on regulations of game commission.

[2] *Quebec.*—Lieutenant governor in council may prohibit sale of any game or prolong any existing period of prohibition for three years or less.

Disposition of game raised in captivity—Continued.

Louisiana: Game raised in captivity may be sold during the open season.

Maryland: Elk, imported and native deer, raised in licensed preserve (fee, $5) may be sold, dead or alive, at any time (in Allegany and Garrett Counties white-tailed deer native to the State must be branded three months prior to killing. The propagation and killing of English or ring-necked pheasants in captivity is permitted. In Washington County game animals and birds reared in licensed preserves (fee, $10) may be sold for propagation only.

Massachusetts: Pheasants on private preserves may be killed under permit of commissioners. Quail reared in captivity under permit may be exported. Game may be reared in captivity under license (no fee) and sold for propagation under regulations of commissioners; deer, elk, pheasants, quail, European or gray partridge, and wild fowl may be reared in captivity under license (no fee) and sold for food, when properly tagged. Tag fee, 5 cents.

Michigan: Deer raised in captivity may be killed at any time for owner's consumption. Game raised in captivity may be exported under permit, and may be sold alive within the State, and under $1 permit, alive or dead, without the State.

Minnesota: Game raised in captivity under license (fee 50 cents for each big game animal) may be sold at any time—game animals under a permit and birds under a tag. Domesticated big game may be exported under permit.

Missouri: Deer and elk raised in captivity under license (fee, $5) may be transported and sold under regulations of the commissioner.

Nevada: Game raised in licensed preserve (fee, $10) may be sold or shipped at any time under invoice.

New Hampshire: Game (except ruffed grouse) raised in private preserve when tagged and marked to show kind and number, names of consignor and consignee, and points of billing and destination, may be exported unaccompanied by the owner. The Blue Mountain Forest Association is permitted to ship deer, elk, and moose killed in its preserve.

New Jersey: Deer raised in licensed preserve may be killed at any time. Deer, introduced pheasants, and mallard and black ducks raised in enclosed licensed preserve, if properly tagged, may be sold for food or exported for sale, if shipped open to view. Live deer may be exported for propagation on payment of $5 for each animal. Breeder's license fee $5.

New Mexico: Game raised in licensed preserve may be exported or sold at any time.

New York: Elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, mallard, and black ducks raised in captivity under license, may be sold for breeding purposes and may be killed, sold, or exported at any time under license when properly tagged. Varying hares and cottontail rabbits bred in captivity under $5 license may be sold for food during close season, when properly tagged, under rules and regulations of the conservation department.

North Carolina: Twenty-two counties have laws in regard to certain game raised in captivity.

North Dakota: Domesticated game may be exported and sold under written permission of fish and game board.

Ohio: English ring-neck, Mongolian, or Chinese pheasants may be bred in captivity under 50-cent permit, and when killed may be sold or shipped if tagged with a distinctive metal tag. Packages for shipment must be labeled to show contents. Game birds and squirrels may be kept in enclosures for domestication.

Oklahoma: Game raised under license (fee, $2) may be transported for propagation at any time, and for food, when properly tagged, during season prescribed by commissioner.

Oregon: Game birds and animals raised in captivity under permit may be exported or sold at any time upon being properly tagged by commissioner or deputy. Tag fee, 5 cents each.

Pennsylvania: Game breeder's license, fee $1, bond $500. Deer, elk, Belgian or German hares, and ring-necked pheasants, raised and killed in captivity, may be sold when properly marked and tagged. Elk raised in captivity may be exported under regulations of the commission. Introduced pheasants and Belgian hares raised in captivity may be exported alive.

South Carolina: Any birds or animals protected by law may be kept in possession for purposes of propagation or domestication.

South Dakota: Game raised in captivity may be exported or sold under written permission of State game warden.

Utah: Game raised in licensed preserve (fee, $25) may be sold when properly tagged (one pair in four of game reared in private preserves must be released in State under direction of commissioner or deputy).

Disposition of game raised in captivity—Continued.

Vermont: Game raised in licensed private preserves (fee, $2) may be exported at any time when duly marked and tagged, and may be sold for propagation at any time, or for food, under tag in accordance with regulations of commissioner.

Washington: Game raised in captivity may be exported under permit from State warden or county game commission, and may be killed and sold at any time.

West Virginia: The owner of elk kept in inclosure may kill them at any time, and may pursue and recapture, by killing or otherwise, elk which have escaped from his inclosure. Tame deer may be killed by the owner.

Wisconsin: Domesticated deer, moose, elk, caribou, and game birds may be shipped or sold under permit of the conservation commission.

Wyoming: Natural increase of big game (except moose) captured and held for propagation may be exported or sold.

LIMITS.

Laws limiting the amount of game which may be killed in a day or a season are now in force throughout the United States, except in Rhode Island, Virginia (except Back Bay), and the District of Columbia, and in all the Canadian Provinces except Prince Edward Island.

One of the first bag-limit statutes on birds, passed in Iowa in 1878,[1] restricted the number of prairie chickens, woodcock, quail, and ruffed grouse to 25 a day. These limits remained unchanged for 35 years until the legislature of 1915 reduced the number of prairie chickens to 8 a day and quail to 15 a day. The first limit law on big game, passed in Maine in 1883, restricted the number killed by one individual in a season to 1 moose, 2 caribou, and 3 deer. In 1895 these limits were reduced to 1 moose, 1 caribou, and 2 deer. In 1899 the season was closed on caribou and in 1915 on moose.

In recent years limits have been materially reduced and only a few States now allow more than 1 deer in a season or more than 20 quail or 25 waterfowl in a day.

LIMITS FIXED BY LAW FOR THE CAPTURE OF GAME.

Alabama: One deer, 2 turkey gobblers, 25 of each other kind of birds a day.

Alaska: Three deer, 2 moose, 3 caribou, 3 sheep, and 3 brown bears a season; 25 grouse, ptarmigan, shore birds, or waterfowl a day.

Arizona: Two deer, 3 turkeys a season, 25 each of quail or ducks, 35 doves or white wings a day.

Arkansas: Two deer, 1 bear, 4 turkeys a season; hunting parties may average season's limit for each member; 15 quail, 25 ducks a day.

California: Two deer, 12 tree squirrels a season; 15 cottontail or bush rabbits a day or 30 a week; 4 grouse a day or 8 a week; 4 sage hens a day or 8 a week; 10 mountain quail a day or 20 a week; 15 valley or desert quail a day or 30 a week; 15 Wilson or jacksnipe, black-breasted or golden plover, or yellowlegs a day or 30 a week; 15 mourning doves a day; 25 ducks or geese a day or 50 a week; 12 honkers or black sea brant a day or 24 a week.

Colorado: Twenty game birds a day, 30 in possession. Persons under 12 years of age limited to half this number of birds.

Connecticut: Six gray squirrels a day, 30 a season; 5 rabbits a day, 35 a season; 5 each of quail, ruffed grouse, pheasant, Hungarian partridge, woodcock a day, 36 a year; 35 rail, 50 each of plover, snipe, shore birds, and 25 waterfowl a day.

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[1] This statute was, however, preceded by one enacted in 1874 permitting the shipment of a dozen game birds a day, provided the birds were not shipped for sale (ch. 69, sec. 1).

Limits fixed by law for the capture of game—Continued.

Delaware: Six animals, 50 rail, 20 ducks, 12 other birds or fowl, except plover, snipe, and reedbirds, a day.

District of Columbia: No limits.

Florida: Three deer, 10 turkeys, and 300 other game birds a year; 1 deer, 2 turkeys, 20 quail, and 25 each of other species a day.

Georgia: Two deer, 15 cat squirrels, 2 turkeys a season; 40 doves or snipe, 50 ducks, and 25 each of any other species of game birds a day.

Idaho: Two deer, 1 elk, 1 ibex, 1 goat a season; 18 quail, 12 each of partridges, sage hens, grouse, pheasants, 24 doves, plover, snipe, ducks, 4 geese a day; but not more than 24 of all kinds in possession.

Illinois: Fifteen squirrels, 12 quail, 3 prairie chickens, 2 cock pheasants, 10 doves, 15 black-breasted and golden plover, 15 snipe, 15 yellowlegs, 15 coots, rails, and gallinules, 15 ducks, 10 geese, 10 brant, 15 other waterfowl a day. Limit in possession, 30 squirrels, 36 quail, 12 prairie chickens, 40 doves, 50 black-breasted and golden plover, jacksnipe, and yellowlegs, 60 coots, rails, and gallinules, 60 ducks, 20 geese, or brant.

Indiana: Fifteen quail, 5 prairie chickens, 15 ducks or other waterfowl a day; 45 birds in possession as result of 3 or more days' consecutive hunting.

Iowa: Fifteen quail a day, 25 in possession; 8 prairie chickens a day, 16 in possession; 25 ducks a day, 50 in possession; 25 each of all other birds and game a day or in possession.

Kansas: Twenty each of doves, plover, ducks, 12 snipe, and 6 each of geese and brant a day.

Kentucky: Twelve quail a day, 12 in possession for each day of hunt; 15 doves a day, 15 in possession for each day of hunt.

Louisiana: Two deer a day or in possession, 5 a season; 15 squirrels, 1 turkey gobbler, 25 doves, ducks, poule d'eau, or chorooks, 50 snipe, 15 of any other game birds a day. Market hunters, 50 ducks or poule d'eau a day.

Maine: Two deer a season (except in Androscoggin, Cumberland, Knox, Kennebec, Lincoln, Sagadahoc, Waldo, and York Counties, limit 1, and in lumber camps, limit 6); 5 each of ruffed grouse and plover, and 10 each of woodcock, snipe, and ducks a day.

Maryland: Four wild turkeys a season; 10 rabbits, 10 squirrels, 12 quail (partridge), 2 ruffed grouse, 3 English pheasants, 6 woodcock, 10 jacksnipe, 15 yellowlegs, 5 black-breasted plover, 50 reedbirds, 50 rail, 10 coots (crow bills), and gallinules a day; 25 waterfowl a day for each licensed gunner (not exceeding four) connected with an outfit.

> *Additional county restrictions:* Allegany, 2 wild turkeys a day. Baltimore, 6 rabbits, 1 jack rabbit, 8 squirrels, 10 quail, 1 English pheasant, 1 ring-necked pheasant, 1 wild turkey a day. Calvert, 6 rabbits a day. Cecil, 5 rabbits, 6 squirrels, 50 blackbirds a day. Frederick, 8 rabbits, 5 woodcock a day. Garrett, 6 birds a day (see State limits for exceptions). Harford, 6 rabbits, 1 jack rabbit, 8 squirrels, 10 quail, 5 woodcock a day or in possession.

Massachusetts: One deer; 15 gray squirrels, 15 ruffed grouse, 20 woodcock, 20 quail a season; 5 gray squirrels, 3 ruffed grouse, 4 woodcock, 4 quail, 15 black ducks a day; pheasants, in counties having open season, 2 a day, 6 a season.

Michigan: One deer a season; partridge, 6 a day, 15 in possession, 25 a season; woodcock, plover, 6 a day, 20 in possession, 25 a season; snipe, yellowlegs, 10 a day, 20 in possession, 25 a season; ducks, geese, brant, 25 a day or in possession, 50 a week (calendar week).

Minnesota: Licensed resident, 1 deer or 1 moose a season (nonresident, 1 of each); 15 ducks, 10 other birds combined a day; 45 ducks, 30 other birds combined in possession.

Mississippi: One deer a day, 5 a season; 10 squirrels, 20 game birds a day.

Missouri: One deer, 2 turkeys, 10 quail, 15 of any other species of birds a day; or 2 deer, 4 turkeys, 15 quail, 25 of any other species of birds in possession.

Montana: Two deer, 1 elk a season; 5 each of grouse, partridges, prairie chickens, fool hens, pheasants, sage hens, and 20 ducks a day.

Nebraska: Ten each squirrels, quail, prairie chickens or grouse, wild geese or brant, and 25 game birds of any other variety a day; 20 squirrels, 10 prairie chickens or grouse, 10 wild geese or brant, or 50 other game birds in possession.

Nevada: One deer, 1 antelope a season; 20 mountain quail, 20 valley quail, 10 sage hens, 6 grouse, 5 plover, and 15 snipe, 20 ducks a day or in possession.

New Hampshire: Two deer a season in Coos, Carroll, and Grafton Counties or 1 in rest of State; 5 hares or rabbits a day; 5 squirrels a day or in possession; 5 quail a day; 10 ruffed grouse a day, 50 a season; 10 woodcock a day, 50 a season; 20 ducks a day.

New Jersey: One deer a season; 10 rabbits, 10 quail, 3 ruffed grouse, 3 English or ring-neck pheasants, 3 Hungarian partridges, 10 woodcock, 30 marsh hens, 20 ducks, 10 each of geese and brant a day or in possession. (Not applicable to dealer in game, hotel keeper, etc., during open season at place of business.)

Limits fixed by law for the capture of game—Continued.

New Mexico: One deer a season; 3 wild turkeys, 5 grouse, 20 quail, 20 doves, 20 ducks a day or in possession.

New York: Two deer, 20 woodcock, 20 grouse, 3 male introduced pheasants a season; 6 varying hares or rabbits, 5 squirrels, 4 woodcock, 4 grouse, 25 waterfowl (limit for one boat or battery, 40), 15 rails, coots, mudhens or gallinules (limit for one boat, 20), 15 shore birds (limit for one boat, 25) a day.

Long Island: Fifty quail, 20 ruffed grouse, 36 male pheasants a season; 10 quail, 4 ruffed grouse, 6 male pheasants, and 6 cottontails or varying hares a day.

North Carolina: Beaufort, quail, ruffed grouse, 15 a day combined; Brunswick, New Hanover, Pender, 15 marsh hens a day; Buncombe, 2 deer a season, 25 partridges, pheasants, wild turkeys, or doves a day; Cabarrus, Mecklenburg, 15 quail (partridges) a day; Clay, 20 quail a day; Cleveland, 10 quail (partridges) a day; Craven, 10 squirrels a day; Dare, 5 deer a season; Haywood, 1 buck a day, 2 a season; 1 pheasant, 1 wild turkey, 15 other birds a day; Henderson, Jackson, 2 bucks a season; Lenoir, 25 quail a day for individual or party; Lincoln, 10 quail a day; Madison, 25 birds a day; Robeson, 12 quail, doves, snipe, ducks a day; Transylvania, 3 deer a season, 5 squirrels, 20 quail (partridges) a day; Vance, 15 game birds a day.

North Dakota: Ten prairie chickens, grouse, plover, combined a day, 20 in possession at one time; 15 snipe, woodcock, rail, ducks, geese, combined, 30 in possession.

Ohio: Five squirrels, 12 each of plover, snipe, woodcock, shore birds, rail, geese, 25 ducks a day.

Oklahoma: One deer a season; 1 turkey (male), March 15–April 15; 1 turkey, November 15–January 1; 10 quail, plover, snipe, or ducks a day, 100 a season, 10 geese or brant a day, 1 swan a season.

Oregon: Three deer a season; 5 silver gray squirrels and 10 quail in 7 consecutive days; 5 sage hens a day, 10 in 7 consecutive days in district 2; 5 ruffed grouse, pheasants, sooty or blue grouse, sage hens, prairie chickens, and Chinese pheasants (only 1 of which may be a female) a day, 10 in 7 consecutive days; 10 doves (State) a day, 20 in 7 consecutive days; 30 shore birds, rails, coots, ducks, and geese in 7 consecutive days.

Pennsylvania: One deer, 1 bear a season; 6 squirrels a day, 20 a week, 40 a season; 10 rabbits a day, 30 a week, 60 a season; 3 hares a day, 15 a week, 30 a season; 8 quail a day, 25 a week, 40 a season; 5 ruffed grouse a day, 20 a week, 30 a season; 4 ring-necked pheasants a day, 10 a week, 20 a season; 4 Hungarian partridges a day, 10 a week, 20 a season; 10 woodcocks a day, 20 a week, 30 a season; 1 wild turkey a week, 2 a season. (Week begins Monday morning and ends Saturday night.)

Rhode Island: No limits.

South Carolina: Five deer a season; 25 quail (partridges), 2 wild turkeys, 25 doves, 12 woodcock a day.

South Dakota: One deer a year; 20 waterfowl, 10 other birds a day; 25 partridges, ruffed grouse, prairie chickens, sharp-tailed (white-breasted) grouse, pheasants, woodcock, golden plover and upland plover in aggregate in possession at one time; 50 snipe and waterfowl in all in possession.

Tennessee: Twenty game birds or animals a day.

Texas: Three deer, 2 antelope, 1 sheep a season; 15 birds a day (3 wild turkeys December 1 to March 1).

Utah: One deer (residents only) a season; 15 quail or doves, 8 other upland birds combined a day or in possession; 12 geese a day, and 25 in all of snipe, ducks, geese a day.

Vermont: One deer and 25 ruffed grouse or woodcock a season; 5 each of rabbits or gray squirrels a day or in possession; 4 each of quail, ruffed grouse, partridges, or woodcock a day; 10 in all of plover, English snipe, and other shore birds a day; 20 ducks a day.

Virginia: Back Bay, Princess Anne County, 35 ducks, geese, and brant a day. Shenandoah County, 15 quail or partridges, 3 pheasants or grouse, 2 wild turkeys a day.

Washington: Two deer, 1 goat, 1 caribou a season; 5 in all of partridges, grouse, prairie chicken, Hungarian partridges, and imported pheasants, 10 quail a day; 25 upland game birds a week; in Kittitas County, 3 in all of sharp-tailed grouse, sage grouse, Chinese or English pheasants, Hungarian partridges a day; 20 ducks, geese, brant, golden plover, jack or Wilson snipe, greater and lesser yellowlegs a week (week ends midnight Saturday night). Limit in possession, 30 ducks, geese, or brant. If the bag of upland game birds includes quail, the limit is 10 a day.

West Virginia: Two deer a season; 12 squirrels a day, 100 a season; 12 quail a day, 96 a season; 6 ruffed grouse a day, 25 a season; 2 wild turkeys a day, 6 a season.

Limits fixed by law for the capture of game—Continued.

Wisconsin: One deer a year; 5 grouse, prairie chickens, woodcock, 10 partridges (2 in Ozaukee and Washington Counties), 15 plover, snipe, coots, rail, rice hens, ducks (except wood duck), 10 geese or brant a day; 20 of all kinds of birds in possession by resident in one day. Local limits: Rabbit in Ozaukee, Washington, and Waushara Counties, 10 a day; in Dodge, Jefferson, Manitowoc, and Waukesha Counties, 15 a day; squirrel in Dodge and Jefferson Counties, 15 a day; in Waushara, 10 a day.

Wyoming: One deer, 2 elk (resident, 1 elk, and 1 additional elk under special license), 1 male sheep a season; 18 birds (of which not more than 6 may be grouse) a day or in possession.

Alberta: One deer, 1 moose, 1 caribou, 2 sheep, 2 goats a season; 10 grouse, partridges, pheasants, prairie chickens, ptarmigan a day, or 100 a season; 5 Hungarian partridges a day, 25 a season.

British Columbia: Three deer of any one species, 4 in all (but only male mule deer); 1 elk, 2 moose (1 in county of Kootenay), 3 caribou, 3 goats, 2 sheep (1 in county of Kootenay), 250 ducks and 250 geese a season; 12 grouse of any one species, 12 prairie chickens, and 6 pheasants a day or in possession.

Manitoba: One in all of deer, elk, moose, caribou, and antelope a season; 15 in all of grouse, partridges, ptarmigan, prairie chickens a day, 50 a season; 20 ducks a day in September, 40 ducks a day in October and November; 10 geese a day.

New Brunswick: Two deer, 1 moose, 1 caribou a season (lumber camp limited to 2 moose, 2 caribou a season); 10 partridges, 10 woodcock, 20 ducks a day.

Newfoundland: Three caribou (stags) a season.

Nova Scotia: One moose a season; 5 ruffed grouse, 10 woodcock a day.

Ontario: One deer, 1 moose, 1 caribou a season; 10 partridges a day, 200 ducks a season. Two or more persons hunting together under license may kill an average of 1 deer each.

Prince Edward Island: No limits.

Quebec: Zone 1: Two deer, 1 moose, 2 caribou a season. Zone 2: Two deer, 1 moose, 4 caribou a season; 3 deer and 3 caribou additional may be taken by persons domiciled in Province under $5 permit.

Saskatchewan: Two in all of deer, elk, moose, caribou a season; 10 in all of grouse, partridges, pheasants, prairie chickens, ptarmigan a day, or 100 a season; 50 waterfowl a day, 250 a season.

Yukon: Six caribou or deer, 2 moose, 2 elk, 2 sheep, 2 goats, 2 musk oxen a season.

MINIMUM AGE LIMITS FOR HUNTING.

With the general adoption of the license system has come the necessity of fixing a minimum age at which licenses may be issued. The practice is by no means uniform, but about half of the States have restrictions of some sort. These restrictions are of three general kinds:

(1) Exemption from the hunting license requirement for children;

(2) Refusal to issue licenses to children; and

(3) Requirement that children must have the written consent of the parent or guardian to obtain a license.

Children under 12 are not required to have a license in Idaho or Utah; under 14 in Montana, Nevada, Oklahoma, or Oregon; residents under 21 (hunting small game) in Minnesota. Children under 13 in New Hampshire, under 18 in Nebraska, and under 17 in Arizona do not require a license when hunting with a licensed adult. New Jersey prohibits children under 10 from hunting with firearms, but upon application of parent or guardian issues a $1 license to citizens of the United States between the ages of 10 and 14, provided they hunt in company with a licensed adult. Pennsylvania also prohibits children under 14 from hunting, but issues licenses to minors between the ages of 14 and 16 upon application of parent or guardian. Ohio prohibits persons under 16 from hunting unless accompanied by parent or guardian.

Licenses are not issued to children under certain ages, or only upon written consent of the parent or guardian, in the following States:

Not issued under certain age:	Age.	Written consent required:	Age.
New Jersey	10	New Jersey	10 to 14
New Hampshire	13	Indiana	14
Oklahoma	14	West Virginia	15
Oregon	14	Pennsylvania	14 to 16
Pennsylvania	14	Ohio	16
Wyoming (birds)	14	Vermont	16
Wyoming (big game)	15	British Columbia	16
Rhode Island	15	Iowa	18
Wisconsin	15	Massachusetts	18
Connecticut	16	New Hampshire	18
New Brunswick (big game)	16	Saskatchewan	18
Michigan (small game)	17		

LICENSES FOR HUNTING GAME.

In Arkansas nonresidents are not permitted to hunt, except on their own premises. In all the States and throughout Canada licenses must be secured before nonresidents can hunt any or certain kinds of game (see fig. 3, p. 56). In 44 States and 7 Canadian Provinces a like restriction is imposed on residents, but the fees are usually much smaller, and often are merely nominal (see fig. 4, p. 56).

A special kind of hunting license, often known as the "alien" license, is being generally adopted to restrict hunting by persons who are not citizens of the country, and is now in force in about half of the States. Following the example of Pennsylvania, the States of Massachusetts, New Jersey, North Dakota, and West Virginia now prohibit aliens from hunting or owning or possessing guns.

In Maine,[1] Wyoming, New Brunswick (on wild lands), and Nova Scotia nonresidents are not permitted to hunt big game unless accompanied by qualified guides.

Landowners or taxpayers are not required to pay the usual fee in a number of States, and no license is required in Texas or Nova Scotia of those hunting in their own county. Special exemptions are made in favor of nonresident members of fish and game clubs by Massachusetts, Rhode Island, and Quebec. In Ontario no fee is charged for a guest license.

In Alberta the resident big-game license is not required in the northern part of the Province. In Newfoundland, free hunting licenses are granted to officers of British warships stationed on the coast for the protection of fisheries. Manitoba provides that the Governor General of Canada, the premier and lieutenant governor, or the premier of any Province may be granted complimentary licenses. Officers of the army or navy stationed in Nova Scotia, nonresident landowners paying taxes to the amount of $30 or more annually in Nova Scotia, and nonresidents owning real estate in Prince Edward Island to the value of $325 and paying taxes thereon, are required to pay fees of $5 only. The son or brother of a bona fide resident returning to Prince Edward Island may obtain a license on payment of $2.50, and a resident may obtain a nonresident guest license for $2.25 per week, provided he receives no compensation from such guest. In Ontario the lieutenant governor in council is authorized to reduce nonresident license fees to the amount charged residents of Ontario by the Province of which applicant is a resident; and any farmer living on his own land in the districts of Haliburton, Muskoka, Parry Sound, Nipissing, Algoma, Thunder Bay, Rainy River, Sudbury, Manitoulin, or Kenora may take one deer a season for his own use without securing the prescribed license. In Quebec, in the discretion of the minister of colonization, mines, and fisheries, poor Indians or settlers may not be compelled to take out the $5 resident license required for an additional number of deer and caribou.

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[1] *Maine:* On wild lands of the State, except from Dec. 1 to 15.

Details in regard to hunting licenses[1] are given in the table on pages 57–62. In every case the fee includes the amount charged for issuing the license. The term "commissioner" unless otherwise qualified means the game or fish commissioner.

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[1] Licenses for fishing with hook and line are now issued in 23 States as follows:

Combination hunting and fishing licenses are issued in 14 States: Arizona, Colorado, Idaho, Indiana, Montana, Nebraska, Nevada, New Jersey, New Mexico, Oregon, Utah, Vermont, Washington, and Wyoming. For fees, see pp. 57–62.

General fishing licenses, issued to either residents or nonresidents, are required in Nevada (30-day license), $2; Oregon, $1; and Vermont, $0.60.

Special resident fishing licenses are required in California, $1; and New Mexico, $1.

Nonresident fishing licenses are required in California, $3; Colorado, $2; Delaware, $3.50; Idaho, $2; Indiana, $1; Maryland (Frederick County), $5; Michigan, $1 (special), $3 (general); Minnesota, $1; Montana, $2 (alien, $5); Nebraska, $2; New Mexico, $5; South Carolina, $5; South Dakota, $2; Washington, $2 (county); West Virginia, $5; and Wisconsin, $1.

Fishing licenses are not required in Idaho of women who are residents; in Indiana of residents fishing in their own county or an adjoining county, nor of the wife of a nonresident licensee; in Michigan the nonresident fishing license is not required of women or minors; in Montana, Nebraska, Nevada, Utah, Vermont, and Wisconsin of any woman; and in Michigan and Minnesota of nonresident minors.

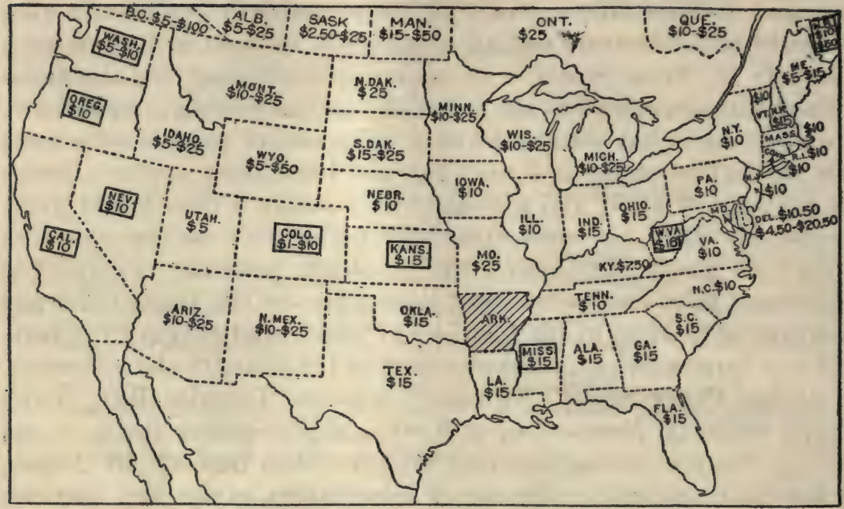

FIG. 3.—States and Provinces which require nonresidents to obtain hunting licenses.

[In Connecticut, Delaware, Illinois, Indiana, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, and Vermont an additional fee of 15 to 50 cents is charged for issuing the license. Inclosed names indicate the States which do not permit licensees to take a limited amount of game out of the State. Alaska and Newfoundland have $50, Nova Scotia $30 and $15, and Prince Edward Island $15 nonresident licenses, with export privileges. Arkansas does not permit hunting by nonresidents, except on their own land.]

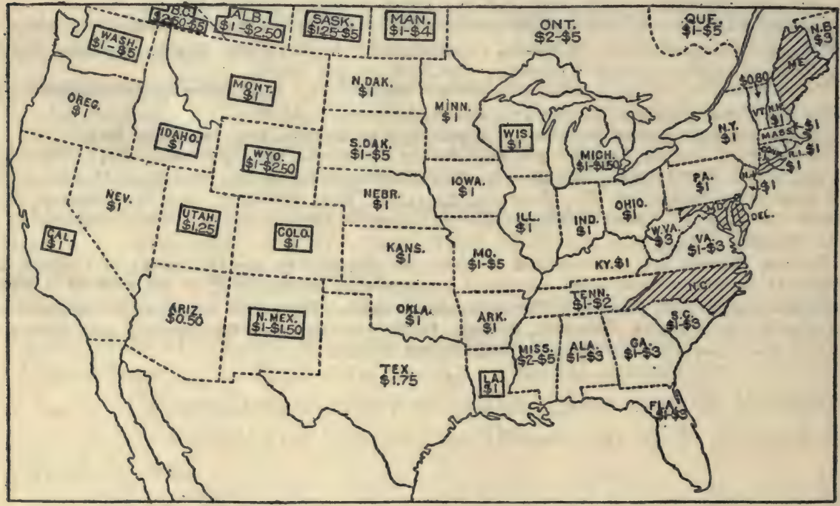

FIG. 4.—States and Provinces which require residents to obtain hunting licenses.

[In Connecticut, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, and South Carolina an additional fee of 10 to 25 cents is charged for issuing the license. West Virginia requires a county license for which no fee is charged. Nova Scotia and Newfoundland have $5 resident licenses for hunting caribou. Note that many of the States adopt the French method of exempting landowners, while a few, mainly in the West (indicated by lines inclosing name of State), follow the English method of requiring everyone who hunts to obtain a license.]

DETAILS OF HUNTING LICENSES.

UNITED STATES.

State and kind of license.	Fee.	By whom issued.	Details of license.
Alabama:			
Nonresident	$15.00	Probate judge	
Alien	15.00	do	
Resident	3.00	do	State license.
Do	1.00	do	County license.
Alaska:			
Nonresident	50.00	Governor	
Alien (nonresident)	100.00	do	
Guide (first class)	25.00	do	American citizen.
Guide (second class)	7.50	do	Native of Alaska. Fees fixed by governor.
Shipping (resident) [1]	40.00	do	Export of heads or trophies by resident.
Do	10.00	do	Do.
Do	5.00	do	Do.
Shipping (special) [1]	150.00	do	Export of moose from southern Alaska.
Arizona:			
Nonresident	25.00	Warden or license collector.	Deer and wild turkey.
Do	10.00	do	Birds and fish.
Alien	100.00	do	Deer.
Do	25.00	do	Birds and fish.
Resident	.50	do	General. Duplicate license, 10 cents.
Arkansas:			
Resident	1.00	Commission	Deer. Nonresidents not permitted to hunt. [2]
California:			
Nonresident	10.00	Fish commissioner or county clerk.	Expires June 30.
Alien	5.00	do	Do.
Resident	21.00	do	Do.
Colorado:			
Nonresident or alien	10.00	Commissioner or county recorder.	
Do	2.00	do	County license—birds, good for 1 week.
Do	1.00	do	County license—birds, good for 1 day.
Do	12.00	do	Hunting and fishing license.
Resident	1.00	do	Do.
Guide	5.00	Commissioner	Must also have State hunting license.
Connecticut:			
Nonresident	10.25	City or borough clerk	Hunting and trapping.
Alien	15.25	do	
Resident citizen	1.25	do	
Delaware:			
Nonresident	10.50	Commission	
Florida:			
Nonresident or alien	15.00	County judge	County license.
Resident	3.00	do	State license.
Do	1.00	do	County license; not required of resident Confederate veteran entitled to a State pension.
Georgia:			
Nonresident	15.00	Commissioner or county warden.	State license.
Resident	3.00	do	Do.
Do	1.00	do	County license good only in county of residence; not required in militia district. Expires Feb. 1.
Idaho: [3]			
Nonresident or alien	25.00	Warden and deputies	Big game. Expires Mar. 31.
Do	5.00	do	Birds only.
Resident	1.00	do	Hunting and fishing. Not required of women.
Illinois:			
Nonresident or alien	10.50	County clerk	Expires June 1.
Resident	1.00	City or county clerk	

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[1] *Alaska:* Not more than one general ($40) license and two special ($150) moose licenses issued to one person in one year. Each shipper must file with the customs office at port of shipment an affidavit that he has not violated the game law; that the trophy to be shipped has not been bought or purchased, has not been sold, and is not shipped for purpose of sale; that he is the owner of the trophy, and, in case of moose, whether the animal from which it was taken was killed north or south of latitude 62°.

[2] *Arkansas;* But see State *v.* Mallory, 83 S. W., 955, deciding that nonresidents may hunt on their own land. A resident is required to obtain written permission for hunting on inclosed land of another.

[3] *Idaho:* Not required of veterans of the Civil War.

Details of hunting licenses—Continued.

State and kind of license.	Fee.	By whom issued.	Details of license.
Indiana:			
Nonresident	$15.50	Clerk of circuit court	Hunting and fishing. Good for 1 year. Civil War veterans exempt.
Resident	1.00	Commissioner or clerk of circuit court.	Do.
Iowa:			
Nonresident or resident alien	10.00	County auditor	Expires July 1.
Resident	1.00	do	
Kansas:			
Nonresident	15.00	Secretary of state	Issued free to honorably discharged soldiers or sailors of United States.
Resident	1.00	County clerk	
Kentucky:			
Nonresident or alien	7.50	County clerk	
Resident	1.00	do	
Louisiana:			
Nonresident or alien	15.00	Tax collector	Issued to residents only.
Market hunting	10.00	do	State license.
Resident	1.00	do	
Trapper	2.00	do	
Maine:			
Nonresident	15.00	Commissioners	All game, Oct. 1–Jan. 1.
Do	5.00	do	Game that may be shot before deer season in certain counties. Holder may obtain big-game license by paying $10 additional.
Resident alien	15.00	do	Not required of aliens who pay taxes or who have resided in State 2 years continuously prior to application.
Camp keeper	5.00	do	
Guide (nonresident)	20.00	do	Guide to be registered, and to guide not more than 5 persons at a time.
Guide (resident)	1.00	do	Do.
Shipping (resident)		do	Moose, $5; deer, $2; one pair of game birds in 7 days, 50 cents.
Trapper	5.00	do	
Maryland:			
Nonresident [1]	4.50 20.50	Clerk of circuit court [2]	Separate county laws.

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[1] *Maryland:* County and local licenses are issued to nonresidents at the following rates (including clerk fees):

Allegany (of State)	[a] $5.00	Howard (of State)	[a] $20.50
Anne Arundel (of county)	5.20	Kent (of county)	[b] 15.50
Baltimore (of State)	[a] 10.20	Montgomery (of county)	15.50
Calvert (of State)	10.50	Patuxent River (of State)	[c] 11.00
Caroline (of county)	5.25	Prince George (of county)	20.50
Carroll (of State)	10.50	Queen Anne (of county)	4.50
Cecil (of county)	10.00	St. Mary (of State)	20.50
Charles (of State)	5.50	Somerset (of State)	[a] 10.50
Dorchester (of State)	[a] 10.00	Talbot (of county)	10.00
Frederick (of county)	[d] 15.50	Washington (of county)	10.00
Garrett (of county)	10.50	Wicomico (of State)	10.50
Harford (of county)	5.15	Worcester (of State)	10.00

County licenses are required of residents at the following rates (including clerk fees):

Allegany (also issued to residents of Garrett and Washington Counties)	$1.00	Dorchester	$1.00
Anne Arundel	1.20	Harford	1.15
Baltimore	1.20	Somerset	2.75
		Washington	.50

[a] Resident of State, Allegany (except also residents of Garrett and Washington Counties), fee $3; Baltimore, fee $5.20; Dorchester, fee $5; Howard, fee $5.50; Somerset, fee $2.75.

[b] Fee only $5.50 if invited by resident landowner.

[c] Club license, $25.

[d] Not required if written permission be secured from landowner or lessee.

Guests: Guests of landowners require no licenses except in Allegany, Baltimore, Caroline, Cecil, Charles, Dorchester (except relatives of host), Frederick, Garrett, Harford, Kent, Talbot, Washington, and Worcester Counties.

Sinkbox, sneak boat, blind, pusher—Cecil: Sneak boat (Bohemia and Elk Rivers), $5.50; sinkbox (Bohemia, Elk, and Sassafras Rivers), $10.50. *Anne Arundel:* Pusher, $2; booby and brush blinds (west side Chesapeake Bay), $5; (South River), $2.50; *Harford:* Sinkbox, $20.75; sneak boat, $5.75. *Kent:* Sinkbox, $20; blind, $5. *Queene Anne:* Sinkbox, $10.50; sneak boat, $5.75; booby blind, $2.50. *Susquehanna Flats:* Sinkbox, $20.75; sneak boat, $5.75. *Talbot:* Sinkbox, $5; blind or sinkbox (Dickson Bay), $5. *Patuxent River:* Pusher, $2.50 (required of residents to push or paddle nonresidents).

Anne Arundel prohibits hunting by nonresidents of the county except by permission of landowners, and Charles prohibits hunting of waterfowl by nonresidents.

[2] In Cecil County by the Cecil County Game Protective Association; in Harford County by justice of the peace.

Details of hunting licenses—Continued.

State and kind of license.	Fee.	By whom issued.	Details of license.
Massachusetts:			
Alien	$15.00	City or town clerk	Applicant must own real estate to the value of $500.
Nonresident	[1] 10.00	do	
Resident	1.00	do	
Michigan:			
Nonresident or alien	25.00	County clerk, warden, or deputy.	Deer.
Do	10.00	do	Small game only.
Resident	1.50	do	Deer.
Do	1.00	do	Small game.
Export	10.00	State warden	
Minnesota:			
Nonresident	25.00	Commissioner	Game animals.
Do	10.00	do	Game birds.
Resident	1.00	County auditor	Deer or moose.
Do	1.00	do	Game birds.
Nonresident (trapper)	10.00	Commissioner	
Mississippi:			
Nonresident	15.00	Sheriff	
Resident	5.00	do	State license.
Do.[2]	2.00	do	County license.
Do. (trapper)	2.50		
Missouri:			
Nonresident	25.00	Commissioner	
Resident	5.00	County clerk or license collector.	State license.
Do	1.00	do	County license. Good in county of residence or adjoining counties.
Montana:			
Nonresident	25.00	Warden	Hunting and fishing.
Do	10.00	do	Birds and fish.
Alien[3]	30.00	do	Hunting and fishing.
Resident [4]	1.00	Warden or justice of peace	Birds and fish.
Guide	10.00	Warden	Issued to residents only.
Shipping (resident)	.50	do	Permits limited exports in open season.
Nebraska:			
Nonresident	10.00	Commissioner or county clerk.	Hunting and fishing.
Resident	1.00	do	Hunting and fishing. Not required of women.
Nevada:[5]			
Nonresident	10.00	County clerk or warden	Hunting and fishing.
Alien	25.00	do	Do.
Resident	1.00	do	Do.
New Hampshire:			
Nonresident or alien	15.00	Commissioner or town clerk.	
Resident	1.00	do	
Guide	1.00	Commissioner	Resident.
Do	20.00	do	Nonresident.
New Jersey:[6]			
Nonresident	10.15	County, city, or town clerk and salaried wardens.	
Resident citizen	1.15	do	Hunting and fishing.
New Mexico:			
Nonresident or resident alien	30.00	County clerk or deputy	All game and fish.
Do	25.00	do	Game.
Nonresident	10.00	do	Birds.
Nonresident alien	55.00	do	All game and fish.
Do	50.00	do	Game.
Resident	2.00	do	All game and fish.
Do	1.50	do	Game.
Do	1.00	do	Big game, including turkeys.
Do	1.00	do	Game birds except turkeys.
Guide	5.00	do	Issued to residents only.

[1] *Massachusetts:* Members of incorporated game clubs owning real estate assessed at not less than $1,000 and organized prior to 1907, owners, or their minor children over 18 years old, of real estate assessed at not less than $500, or nonresidents invited (for not more than 4 days) by members of incorporated club for hunting foxes, pay a fee of $1.

[2] *Mississippi:* County license issued to head of family may also be used by minor members of family residing with him. Nonresidents prohibited from trapping.

[3] *Montana:* Aliens who do not hold a general hunting license are required to obtain a $25 license from the State warden to possess pistols or other firearms.

[4] United States officers and soldiers stationed in the State, students of any institution of learning, and officers of the United States Forest Service classed as residents.

[5] *Nevada:* No license is required of women for hunting or fishing.

[6] *New Jersey:* Unnaturalized, foreign-born person prohibited from hunting or owning shotgun or rifle unless he is the owner of real property to the value of $2,000 above all encumbrances.

Details of hunting licenses—Continued.

State and kind of license.	Fee.	By whom issued.	Details of license.
New York:			
Nonresident or alien	10.50	County, city, or town clerk.	
Resident	1.10	do	
North Carolina:			
Nonresident (Audubon)	$10.25	Clerk of superior court	Good only in 32 counties not covered by the following or by local licenses.
Nonresident (special)[1]	10.50	do	Good only in county of issue.
North Dakota:			
Nonresident	25.00	Commissioners, deputies, or county auditor.	Aliens not permitted to hunt.
Resident	1.00	do	
Ohio:			
Nonresident	15.25	Clerk of county court or town clerk.	
Resident	1.25	do	
Oklahoma:			
Nonresident	15.00	Warden, deputy, or county clerk.	All game except deer, turkey, or prairie chicken. Expires May 1.
Alien	25.00	do	Do.
Resident citizen	1.25	do	
Oregon:[2]			
Nonresident	10.00	County clerk	
Alien	25.00	Commission	Gun license. Does not permit hunting.
Resident	1.00	County clerk	
Pennsylvania:			
Nonresident	10.00	County treasurer	Aliens not permitted to hunt.
Resident	1.15	County treasurer or justice of peace.	
Rhode Island:			
Nonresident[3]	10.15	City or town clerk	
Alien	15.15	do	
Resident	1.15	do	
South Carolina:			
Nonresident and alien	15.25	County clerk	All game.
Resident[4]	1.10	County clerk or game warden.	County license. Hunting on land of another in county of residence permitted under written permission.
Do	3.00	County treasurer	State license.
South Dakota:			
Nonresident	25.00	Warden or county treasurer.	Big game and game birds. Expires June 30.
Do	15.00	do	Game birds only.
Resident	5.00	County treasurer	County license. Big game.
Do	1.00	do	Game birds.
Tennessee:			
Nonresident	10.00	County clerk	
Resident	1.00	do	County license.
Do	2.00	do	State license.
Market hunting	25.00	do	Annual license; $200 bond required.
Texas:			
Noncitizen	15.00	Commissioner	Expires Sept. 1.
Resident	1.75	County clerk	Do.
Utah:			
Nonresident	5.00	Commissioner, deputy, or justice of peace.	Hunting and fishing. Not required for rabbits.
Alien	15.00	do	Do.
Resident	1.25	do	Hunting and fishing. Not required for hunting rabbits, or of women.

[1] *North Corolina;* Issued in the following 58 counties: Beaufort, Bertie, Cabarrus, Camden, Carteret, Caswell, Catawba, Cherokee, Chowan, Clay, Cleveland, Currituck, Dare, Davidson, Davie, Duplin, Forsyth, Franklin, Gaston, Gates, Graham, Granville, Halifax, Harnett, Henderson, Hertford, Hyde, Jackson, Johnston, Jones, Lincoln, Macon, Madison, Martin, Mitchell, Montgomery, Nash, Pamlico, Pasquotank, Pender, Perquimans, Pitt, Polk, Randolph, Richmond, Sampson, Stanly, Stokes, Swain, Transylvania, Tyrrell, Union, Vance, Washington, Wayne, Wilkes, Wilson, Yadkin. Special license provisions are in force in Alexander, Caswell, Clay, Craven, Dare (wild fowl), Haywood, Hoke, Jackson, Lincoln, Northampton, Onslow, Pamlico, Pender, Robeson, Warren, and Yancey Counties. Details of these are given in Poster No. 33, copies of which may be had free on application to the Biological Survey, U. S. Department of Agriculture.

[2] *Oregon:* Veterans of the Civil War pay no fee for license; women not required to obtain license.

[3] *Rhode Island:* Nonresident citizens and members of hunting or fishing clubs incorporated prior to Jan. 1, 1909, owning real estate to the value of $1,000, and nonresident citizens owning real estate assessed at not less than $500, pay a fee of $1.15.

[4] *South Carolina:* Resident licenses are required in all counties except the following: Aiken, Berkeley, Cherokee, Chesterfield, Clarendon, Colleton, Georgetown, Greenwood, Lancaster, Marlboro, Williamsburg, and York.

Details of hunting licenses—Continued.

State and kind of license.	Fee.	By whom issued.	Details of license.
Vermont:			
Nonresident [1]	$10.50	Town clerk	Hunting and fishing.
Do	.60	do	Fishing.
Resident	1.00	do	Hunting and fishing.
Do	.60	do	Hunting or fishing.
Virginia: [2]			
Nonresident [3]	10.00	Clerk circuit court	
Alien [4]	20.00	do	
Resident	3.00	do	State license.
Do	1.00	do	County license.
Washington:			
Nonresident	10.00	State auditor	State license. Expires Mar. 1.
Do	5.00	County auditor	County license.
Alien	15.00	State auditor	Gun license. Consular certificate required.[5]
Resident	5.00	do	State license.
Do	1.00	County auditor	County license.
West Virginia:			
Nonresident	16.00	County clerk	State license. Aliens not permitted to hunt.
Resident		do	No fee. County license.
Do	3.00	do	State license. Required outside county of residence.
Wisconsin: [6]			
Nonresident	25.00	Secretary of state	All game.
Do	10.00	do	All game except deer.
Resident	1.00	County clerk	
Wyoming:			
Nonresident or alien	50.00	Justice of peace, assistant warden, or deputy.	Hunting and fishing.
Nonresident	10.00	do	Bears only.
Do	5.00	do	Birds and fish.
Alien	5.00	do	Birds only.
Resident [7]	2.50	Justice of peace or game warden.	Ordinary.
Do	10.00	do	1 additional elk. Issued to holder of ordinary resident license.
Do	1.00	do	Birds only.
Guide [8]	10.00	Justice of peace	
Alien	25.00	do	Gun and fishing license. Not required of holder of $50 alien hunting license, bona fide residents, or freeholder paying taxes in excess of $100.
Alberta:			
Nonresident	25.00	Minister of agriculture	General.
Do	5.00	do	Birds only.
Guide, camp help	2.50	do	Resident only.
Resident [9]	2.50	do	Big game.
Do	2.25	do	Birds. Required south of lat. 55°.
Do	1.00	do	Required of residents of city or town.
Market hunting	5.00	do	
British Columbia:			
Nonresident	100.00	Warden or any Government agent.	Members of army, navy, or militia in actual service exempt.
Do	50.00	do	Birds only. Good Sept. 1–Mar. 31.
Do	25.00	do	Bears only. Good Jan. 1–July 15.
Do	5.00	do	Birds only. British subject. Good for 1 week.

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[1] *Vermont:* Fee, 60 cents if applicant pays taxes on improved real estate in Vermont appraised at $1,000.

[2] *Virginia:* Rappahannock County requires written and duly acknowledged permission (good for 4 months) before permitting hunting or trapping on another's land.

[3] A nonresident may hunt upon his own lands in the State without a license.

[4] Aliens who have resided in the State for 5 years and who own real estate therein may obtain resident licenses.

[5] *Washington:* Holder may then secure $1 county hunting and fishing license or a $5 State license.

[6] *Wisconsin:* Bona fide settler who has not resided in the State 1 year may take out a special resident license. Holder of nonresident special license may obtain general license on payment of $15 additional.

[7] *Wyoming:* Applicant must be an elector of the State; a child or ward, over 15 years, of an elector; a soldier or sailor of the United States and an elector thereof, stationed 1 year at a post in the State; or a nonresident paying $100 or more taxes on property owned in the State; or an officer employed in the State by the National Forest Service. Soldier or sailor must employ guide.

[8] Guide must be citizen and qualified elector of State, a freeholder or have a valid filing on public lands in the State, must act as assistant game warden, and make sworn report to game warden; required to furnish $500 bond.

[9] *Alberta:* Farmers or their sons residing on own land, fee $1; bird license not required of farmer or member of family residing with him upon his farm, or of residents north of lat. 55°. Residents north of lat. 55° may also take one head of big game (except elk or buffalo) without big game license.

Details of hunting licenses—Continued.

Province and kind of license.	Fee.	By whom issued.	Details of license.
British Columbia—Continued.			
Resident	$2.50	Warden or any Government agent.	Birds and deer only.
Do	5.00	do	Birds and all big game.
Do	10.00	do	Birds, all big game, and trapping.
Guide	5.00	do	
Manitoba:			
Nonresident (alien)	50.00	Minister of agriculture	
Nonresident (British subject)	15.00	do	
Resident	4.00	do	Big game only.
Do.[1]	1.00	do	Birds only.
New Brunswick: [2]			
Nonresident	50.00	Minister of land and mines	Moose, caribou, and deer.
Do	25.00	do	Game birds. Special license for Westmoreland County.
Do	10.00	do	Game birds.
Resident	3.00	do	Moose, caribou, and deer.
Sinkbox	1.00	do	For geese and brant.
Guide	1.00	do	Resident. Registration fee, $2.
Camp help	1.00	do	Resident.
Do	50.00	do	Nonresident.
Newfoundland:			
Nonresident	51.00	Game and fisheries board	Can not employ unlicensed guide.
Guide	50.00	do	Nonresident. Resident guide licenses free.
Resident	5.00	do	3 caribou not for traffic.
Householder		do	Do.
Nova Scotia: [3]			
Nonresident	30.00	Provincial secretary, game commissioners, or county clerk.	All game. Expires Aug. 1.
Do	15.00	do	Birds and small game, except woodcock and snipe.
Alien	5.00	do	Required of aliens who have not resided in Province 5 years.
Resident	5.00	do	For caribou outside county of residence.
Guide	2.00	do	Resident. Expires Aug. 1.
Ontario:			
Nonresident	25.00	Superintendent of game	All game.
Resident	5.00	do	Moose and caribou.
Do	2.00	do	Deer.
Guide	2.00	do	
Prince Edward Island:			
Nonresident	15.00	Game inspector or tax collector.	All game. Expires 1 year after date. If applicant pays taxes on real estate to the value of $325, fee $5.
Quebec:			
Nonresident	25.00	Minister of colonization	All game.
Do	10.00	do	Issued to members of incorporated hunting clubs.
Resident	1.00	do	Big game. Not required of persons hunting for own use.
Do	5.00	do	3 deer and 3 caribou additional to bag limit.
Saskatchewan:			
Nonresident	25.00	Minister of agriculture	Big game only.
Do	10.00	do	Birds only.
Do	2.50	do	Birds only. Good for 6 days.
Resident	5.00	Minister or agent	Big game.
Do	1.25	do	Birds only. Required of resident of city or town.
Yukon:			
Nonresident	100.00	Commissioner or game guardian.	All game.

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[1] *Manitoba:* Not required of farmer or member of family actually residing on farm in Province.

[2] *New Brunswick:* Nonresident hunting big game must be in charge of a registered guide.

[3] *Nova Scotia:* Nonresident hunting big game must be in charge of a registered guide. Nonresident paying taxes on real estate to the amount of the license fee, required to pay only $5.

OFFICIALS FROM WHOM STATE OR PROVINCIAL GAME LAWS MAY BE OBTAINED.

Alabama:
State game and fish commissioner, Montgomery.

Alaska: The governor, Juneau.
Secretary of Agriculture, Washington, D. C.

Arizona:
State game warden, Phoenix.

Arkansas:
Secretary, game and fish commission, Little Rock.

California:
Executive officer, fish and game commission, New Call Building, San Francisco.

Colorado:
State game and fish commissioner, Denver.

Connecticut:
Secretary, commission of fisheries and game, Hartford.

Delaware:
Chief game warden, Dover.

District of Columbia:
Supt. Metropolitan Police, Washington, D. C.

Florida:
Secretary of state, Tallahassee.

Georgia:
Game and fish commissioner, Atlanta.

Idaho:
Fish and game warden, Boise.

Illinois:
Game and fish commission, Springfield.

Indiana:
Commissioner fisheries and game, Indianapolis.

Iowa:
State fish and game warden, Spirit Lake.

Kansas:
State fish and game warden, Pratt.

Kentucky:
Executive agent, game and fish commission, Frankfort.

Louisiana:
Commissioner of conservation, Court Building, New Orleans.

Maine:
Commission of inland fisheries and game, Augusta.

Maryland:
Game warden, 512 Munsey Building, Baltimore.

Massachusetts:
Chairman, commissioners of fisheries and game, State House, Boston.

Michigan:
Commissioner game, fish, and forest-fire department, Lansing.

Minnesota:
Game and fish commissioner, St. Paul.

Mississippi:
Game and fish commissioner, Jackson.

Missouri:
Game and fish commissioner, Jefferson City.

Montana:
State game warden, Helena.

Nebraska:
Chief deputy, game and fish commission, Lincoln.

Nevada:
Secretary of state, Carson City.

New Hampshire:
Fish and game commissioner, Milford.

New Jersey:
Secretary board of fish and game commissioners, Trenton.

New Mexico:
Game and fish warden, Santa Fe.

New York:
Secretary of conservation commission, Albany.

North Carolina:
Secretary Audubon Society of North Carolina, Raleigh.

North Dakota:
Secretary game and fish board, Fargo.

Ohio:
Chief game warden, Board of Agriculture, Columbus.

Oklahoma:
State game warden, Oklahoma City.

Oregon:
State game warden, Portland.

Pennsylvania:
Secretary board of game commissioners, Harrisburg.

Rhode Island:
Chairman, commissioners of birds, Rumford.

South Carolina:
Chief game warden, Columbia.

South Dakota:
State game warden, Pierre.

Tennessee:
State game and fish warden, Nashville.

Texas:
Game, fish, and oyster commissioner, Austin.

Utah:
Fish and game commissioner, Salt Lake City.

Vermont:
Fish and game commissioner, Lyndonville.

Officials from whom State or Provincial game laws may be obtained—Con.

Virginia:
Commissioner of game and inland fisheries, Richmond.

Washington:
Chief game warden and State fish commissioner, Seattle.
Chief deputy game warden, Spokane.

West Virginia:
Forest, game, and fish warden, Belington.

Wisconsin:
Secretary conservation commission, Madison.

Wyoming:
State game warden, Lander.

CANADA.

Alberta:
Chief game guardian, Edmonton.

British Columbia:
Provincial game warden, Vancouver.

Manitoba:
Chief game guardian, Winnipeg.

New Brunswick:
Chief game and fire warden, Richibucto.

Newfoundland:
Secretary department of marine and fisheries, St. Johns.

Nova Scotia:
Chief game commissioner, Halifax.

Ontario:
Superintendent game and fisheries, Toronto.

Prince Edward Island:
Game inspector, Charlottetown.

Quebec:
General inspector of fisheries and game, Quebec.

Saskatchewan:
Chief game guardian, Regina.

Yukon:
Territorial secretary, Dawson.

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UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 775 NOVEMBER 10, 1916

Contribution from Office of Markets and Rural Organization, Charles J. Brand, Chief.

LOSSES FROM SELLING COTTON IN THE SEED.

By CHARLES F. CRESWELL, *Scientific Assistant*.

CONTENTS.

	Page.
Reasons why cotton is sold in the seed	2
Disadvantages of selling cotton in the seed	2
Difficulty of determining a just seed-cotton price	3
Ginned cotton brings higher prices than unginned cotton	4
Inconsistencies in prices received for the lint content of seed cotton	5
Prices resulting from different lint percentages	6
Recommendations	6

In the majority of cases, when the farmer sells his cotton in the seed he loses money, yet a large part of the crop is so marketed in many local markets. A much larger proportion of the total crop of cotton is sold in the seed in Missouri and Virginia than in any other States, while the largest number of bales so sold is in Oklahoma. Of the entire crop, 8.5 per cent, equaling 937,000 bales, was sold in the seed during 1915; and 8.6 per cent, equaling 1,203,000 bales, was sold in the seed during 1913. The percentage for 1914 was less than during these two years because much cotton was held by producers on account of the low prices resulting from the European war.

In January, 1916, the U. S. Department of Agriculture estimated the number of bales of cotton sold in the seed in the several cotton-producing States. Table I is presented to show these estimates.

TABLE I.—*Amount of cotton sold in the seed during 1915.*

State.	Percentage sold in the seed.	Total crop.[1]	Estimated amount sold in the seed.
	Per cent.	*Bales.*	*Bales.*
Virginia	60	16,357	10,000
North Carolina	11	737,354	81,000
South Carolina	2	1,174,213	23.000
Georgia	2	1,937,730	39,000
Florida	45	55,354	25,000
Alabama	4	1,025,818	41,000
Mississippi	3	925,509	28,000
Louisiana	4	336,813	13,000
Texas	6	3,068,852	184,000
Arkansas	13	789,583	103,000
Tennessee	40	296,222	118,000
Missouri	90	46,644	42,000
Oklahoma	37	622,176	230.000
Summary	8.5	[2]11,032,625	937,000

[1] Census Bureau figures. [2] Does not include 35,548 bales produced in States other than those shown.

NOTE.—The facts set forth in this bulletin are based on personal interviews during May and June of 1916 with farmers, ginners, oil-mill men, and others in all the important sections where cotton is sold in the seed, and on a study of seed-cotton marketing made in Oklahoma during the 1913–14 season. See Creswell, Charles F.: Disadvantages of Selling Cotton in the Seed, U. S. Department of Agriculture Bulletin 375. 1916.

This bulletin should be of interest to cotton producers, ginners, and buyers generally.

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REASONS WHY COTTON IS SOLD IN THE SEED.

In regions where cotton is sold in the seed, the producer is able to make a ready cash sale of any amount of unginned cotton that he may bring to the gin. In most markets, practically the only advantage accruing to the farmers as a class, however, is the saving of the time of men and teams which otherwise would be spent in awaiting their turns at the gins and in selling the baled lint cotton.

In nearly every section where unginned cotton is sold to any considerable extent, oil mills either own or control gins and buy seed cotton principally to secure the cotton seed. Such oil mills often encourage producers to sell their cotton in this way.

In many communities where production is scanty, or where too little cotton is produced to allow the gins to run daily, cotton often is sold unginned. The custom started in this way in some sections and was not discontinued when the production became large enough to make custom ginning practicable.

In Virginia and in the eastern part of North Carolina some cotton is sold and planted on a contract basis. The ginner enters into an agreement with the producer to buy the seed cotton produced on a specified area at a certain price per pound. This assures the farmer of a reasonable price for his cotton and the ginner of a certain amount of business during the approaching season.

It is a somewhat general practice throughout the cotton belt for producers to sell their last pickings of less than bale lots in the seed. However, farmers often put their remnants together or buy sufficient seed cotton from other farmers to complete a bale rather than sell their cotton unginned.

DISADVANTAGES OF SELLING COTTON IN THE SEED.

The selling of cotton in the seed is subject to several uncertain factors, which result in many disadvantages to the producer. The percentages of lint, seed, and trash may be much greater in one load of seed cotton than in another, and the two loads may grade very differently. These great differences and the inability of either the producer or the ginner to determine accurately the grade or the percentages of lint, seed, and trash in seed cotton result in dealing on a basis of averages, and the ginner naturally is careful to see that he secures his ginning charge and a profit and is protected against any losses which may arise from the variable elements involved. This method of dealing results in money losses to the cotton producer in the majority of cases and causes great variations in the prices which different individuals receive for cotton of the same quality and wide irregularities in prices received for cotton of different qualities.

A ginner often buys on one day several times as many loads of seed cotton as he is able to gin during the day. This seed cotton usually is separated into about three grades, without regard to variety, character, or length of staple. It follows that the different varieties of seed as well as the different grades, characters, and lengths of lint produced in a community are mixed at the gin. Much of the gin-run seed is planted, causing a mixture of varieties and lengths of staple in the field. The mixing of grades and staples results in an absolute loss, from which no person gains. Such a condition, if not already detected, sooner or later will be discovered by discriminating buyers and can not fail to reflect on the local market to the detriment of the producer.

Selling cotton in the seed hinders improvement in quality. It is difficult for the grower to obtain his own seed for planting and he is encouraged to improve his product with the sole object of increasing the yield of seed cotton per acre. Grade and staple are so little considered by the buyer of seed cotton that they frequently are treated with indifference by the grower and but little attention is given to the quality of the fiber. Where this method of selling prevails, the better cotton when sold in the seed brings so small a premium that the grower is not encouraged to produce and bring to market superior seed cotton free from an excess of dirt, trash, and moisture.

In those communities where most of the cotton is sold in the seed there is usually a restricted market for lint cotton, as not enough cotton is sold in the bale to attract regular buyers. The bales often are purchased from the ginner by large buyers, who sometimes buy on an average gin-run basis without grading the lot. This condition does not tend to encourage keen competition and close discrimination as to grade and staple in the purchase of lint cotton. Therefore, the grower who desires to produce cotton of good quality and sell his lint and seed separately is placed at a disadvantage.

The seller of lint cotton can compare the prices offered for his product with the prices being paid in large interior markets and at the ports, as published in the daily papers, and thus can ascertain whether he is receiving reasonable offers. On the other hand, the farmer who sells seed cotton does not know the price which his lint brings, and, therefore, can not check his offers against prices being paid for lint cotton in other markets.

DIFFICULTY OF DETERMINING A JUST SEED-COTTON PRICE.

The grades of lint and the percentages of lint, seed, and trash vary greatly in different loads of seed cotton.[1] The inability of the ginner or the producer to determine accurately these uncertain elements before ginning makes it impossible to figure a just price to be paid for each load. The best that can be done, under the circumstances, is to consider the current lint and seed prices and the average lint, seed, and trash contents of the entire community as a basis for reaching the price to be paid for unginned cotton. The ginner often offers a uniform price for practically all seed cotton with little regard for quality, although, if a load appears to be much worse than the average in trash or moisture content, a lower price may be offered. In fixing the price the buyer naturally is careful to guard against any losses that may be incurred on account of the uncertainties involved and to figure safely his own profit.

Many cases were found during a survey conducted in Oklahoma during the 1913–14 season where, in the same market, on the same day, the same price per hundred pounds was paid for all unginned cotton, apparently with an utter disregard for quality, the ginner probably expecting to overcome any losses on the poorer loads by gains on the better ones. The range in price paid for seed cotton on any one day was comparatively small, and many instances were found where the load containing the best lint brought the producer a lower price per pound for the lint than did the load which yielded the poorest lint.

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[1] In the same market during the same week the grade has ranged from below Good Ordinary to Strict Good Middling; the lint content has varied 11 per cent, the seed content 23 per cent, and the trash content 22 per cent. Loads of the same variety of cotton often differ greatly in these respects on the same day. It is seldom that two loads of cotton will be identical in grade and in lint, seed and trash proportions in the same market on the same day.

GINNED COTTON BRINGS HIGHER PRICES THAN UNGINNED COTTON.

On October 13, 1913, a farmer brought a load of seed cotton to a certain Oklahoma town where there was a market for both ginned and unginned cotton. He decided to sell his cotton in the seed and received a price of $3.50 per 100 pounds, amounting to $55.77 for the load. This load of seed cotton contained 30 per cent of lint, 64 per cent of seed, and 6 per cent of trash, and yielded lint of the grade of Strict Low Middling. If this lot of seed cotton had been custom ginned the farmer would have had 478 pounds of lint, on which would have been placed 22 pounds of bagging and ties, making a 500-pound gross weight bale. He also would have had 1,020 pounds of cotton seed, which could have been sold for approximately $10.20. The ginner would have assessed a charge for ginning and wrapping of approximately $3.50. Therefore, the producer received for his load of seed cotton the equal of $49.07 per 500-pound gross weight bale, or 9.81 cents per pound, for baled lint cotton. During the week and in the market where this load of seed cotton was sold information was obtained as to the sale of 12 bales of ginned cotton of the same grade, which brought an average price of $60.05 per bale, in addition to the amounts received by the producers for their cotton seed. It may be assumed, therefore, that in this case the decision of the farmer to sell his cotton unginned cost him approximately the difference between $60.05 and $49.07, or $10.98 per bale.

Another farmer sold for $55.77 a load of seed cotton which contained 30 per cent of lint and 68 per cent of seed. If this load had been ginned the farmer could have sold his seed for approximately $10.83. After allowing for the value of the seed and for the cost of ginning, the lint cotton, which graded Strict Good Middling, brought $48.44 per bale. Cotton of the same grade which had been ginned was selling at an average of $64.30. Therefore this farmer lost approximately $15.86 by selling his cotton unginned.

One producer who had his cotton ginned sold a bale of Middling for $66.25, while another producer who sold cotton unginned received only $49.90 per bale for lint of the same grade. A bale of Low Middling was sold for $60, while a lot of the same grade was sold unginned at an equivalent of $37.80 per bale. A Low Middling bale brought $61.50, while a lot sold in the seed brought only $40.90 per bale for lint which graded Strict Low Middling. Three bales of Strict Low Middling brought the producers an average of $61.25, while 3 lots of the same grade which were sold in the seed brought the producers only $49.65 per bale for the lint.

Producers in Oklahoma who sold cotton in the seed during the 1913–14 season suffered as a result average losses on all grades of cotton as follows: Good Ordinary, $4.55; Strict Good Ordinary, $3.25; Low Middling, $1.75; Strict Low Middling, $3.60; Middling, $6.90; Strict Middling, $7.40; Good Middling, $7.60, and averaging $4.63 per bale for all the white grades. The producers lost during each month average sums ranging from $3.85 per bale for October to $10.25 for December and averaging $6.06 per bale, including off-colored cotton as well as the white grades. Both seed-cotton and lint-cotton sales were studied in the same market during the same week in 14 instances. In one of these cases it was found that the producers gained an average of $3.55 per bale, but in the other 13 cases average losses were sustained ranging from $4.45 to $17.70 per bale and averaging $7.59 per bale for the 14 instances.

It is apparent that seed-cotton selling is an uncertain proposition and usually results in losses on all grades to individual producers as well as to producers as a whole in any market where cotton is so sold.

INCONSISTENCIES IN PRICES RECEIVED FOR THE LINT CONTENT OF SEED COTTON.

When cotton is sold in the seed producers receive widely varying prices for the lint, on account of the various uncertain elements involved. In the same market on the same day one lot of cotton sold in the seed often brings from $5 to $10 per bale more for its lint content than another lot of the same grade; a difference as great as $26.05 has been found. The lowest quality of lint that is sold in the seed on a given day often will bring more than the highest quality so sold in the same market. Frequently the highest price paid in a market (that is, the price which figures out most for the lint) is for cotton of lower quality than that for which the lowest price is paid.

In the course of an investigation conducted in Oklahoma during the season of 1913–14, 84 comparisons were made between prices received for loads of seed cotton sold in the same week at the same place. In 34 cases the extreme irregularities in prices, quality considered, was more than $15 per bale; in 32 cases from $10 to $15; and in only 18 cases was the difference less than $10, the smallest difference being 95 cents per bale.

On one day in a certain market, a bale of Strict Good Middling sold in the seed at 9.62 cents per pound of lint, while a bale below Good Ordinary sold for 10.10 cents per pound. According to New Orleans spot quotations, the Strict Good Middling was worth 3.38 cents per pound more than the other bale but sold for 0.48 of a cent less, making a discrepancy between the prices received for the two lots of 3.86 cents per pound, or $19.30 per bale. On another day a bale of Good Middling sold in the seed for 7.55 cents per pound of lint while a bale below Good Ordinary sold for 8.37 cents per pound. According to New Orleans spot quotations the Good Middling was worth 3.44 cents per pound more than the other bale, but sold for 0.82 of a cent less, making a discrepancy of 4.26 cents per pound, or $21.30 per bale. Even the lower grade bale brought less than should have been received in accordance with spot quotations at New Orleans.

These are only two of many illustrations that could be given to show the risk to which the producer who sells seed cotton is subject. He can not ascertain the grade or the percentages of lint, seed, and trash contained in the load, and may unknowingly sell high-grade cotton for less money than other farmers are receiving for low-grade cotton. While the producer sometimes receives more money for individual loads of low-grade cotton by selling in the seed, in a majority of cases he loses on low-grade as well as on high-grade cotton.

PRICES RESULTING FROM DIFFERENT LINT PERCENTAGES.

It is generally admitted that the percentages of lint can not be determined accurately before the cotton is ginned. Investigations have shown that there are wide differences in lint content between different loads sold in the same market on the same day, and that many inconsistencies in prices result from varying lint percentages. In order that the producer might have some means of estimating the extent to which his proceeds may be affected by variations in lint content, Tables II to VI (see pp. 7 and 8) have been prepared. The compilations have been made on the following basis: Ginning charge of $3.50, tare of 22 pounds per bale, trash content of 5 per cent, and gross-weight bale of 500 pounds. These amounts are not the same in all sections, but the tables will show approximate differences resulting from different percentages of lint.

When it is desired to approximate the equivalent lint price that will result from a certain sale of seed cotton, the table should be selected which is figured on the cottonseed price nearest to the price of cotton seed at the time. In the table the seed-cotton price should be selected which is nearest to the price at which the sale is made. The lint prices resulting from different percentages of lint can then be estimated closely, provided the ginning charge is approximately $3.50 and the trash content approximately 5 per cent.

For instance, by referring to Table II it will be seen that when cotton seed is worth $20 per ton the producer who sells for $4 per 100 pounds a load of seed cotton which yields only 27 per cent of lint gets 12.95 cents per pound for the lint, while a load yielding 35 per cent of lint will bring only 10.37 cents per pound of lint, a difference of $12.90 per bale. Under the same conditions a load of cotton yielding 32 per cent of lint will bring $1.50 per bale less for the lint than a load yielding 31 per cent of lint. By referring to Table III it will be seen that when cotton seed is worth $25 per ton and seed cotton is bringing $4 per 100 pounds, a load containing 35 per cent of lint will bring $11.90 less per bale for the lint than another load containing 27 per cent of lint. Under the same conditions a load containing 31 per cent of lint will bring $1.45 per bale more for the lint than a load containing 32 per cent of lint.

Thus, it is shown that the uncertain element of lint percentage will cause great inconsistencies, quality considered, between prices received for cotton sold unginned. By selling his cotton in the seed the producer of seed cotton containing a high percentage of lint is likely to receive much less per pound for the lint in his product than the producer of seed cotton containing a low percentage of lint.

RECOMMENDATIONS.

The percentages of lint, seed, and trash, and the quality of lint vary greatly in different loads of seed cotton and it is impossible for the ginner or the producer to determine these elements accurately before ginning. These uncertain factors result in wide discrepancies in prices received by individual producers who sell cotton in the seed. Selling cotton in the seed also results in losses to producers as a class. At the same time it tends to lower the quality of cotton in those communities where this practice prevails.

Copies of the Official Cotton Standards of the United States have been sent to many of the county demonstration agents for exhibition in public places for the use of farmers and others in marketing cotton. Thereby an opportunity is extended to the farmer who has his cotton ginned to compare a sample of his lint with the Official Cotton Standards, and in this way form some idea as to the grade of his cotton. With such information he can check offers made for his cotton against published quotations of larger markets and thus be in a position to determine whether a reasonable price is offered for his product.

The producers in each community are urged to grow a single variety of good-quality cotton and to exercise care in picking and handling so that they may bring to market high-grade cotton. They also are advised to discontinue selling cotton in the seed and encourage custom ginning so that they may have some knowledge of the value of their product and may sell cotton on its merits.

PRICES OF LINT COTTON CALCULATED FROM CERTAIN SEED-COTTON PRICES AND CERTAIN LINT PERCENTAGES.

(Based on ginning charge of $3.50 per bale, tare of 22 pounds per bale, trash content of 5 per cent and 500-pound gross weight bale.)

TABLE II.—*Lint prices per pound, assuming a cottonseed price of $20 per ton.*

Lint outturn.[1]	Seed-cotton price per 100 pounds.									
	$3.00	$3.25	$3.50	$3.75	$4.00	$4.25	$4.50	$4.75	$5.00	$5.25
Per cent.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
27	9.25	10.17	11.10	12.03	12.95	13.88	14.80	15.73	16.66	17.58
28	8.98	9.87	10.76	11.66	12.55	13.44	14.34	15.23	16.12	17.01
29	8.72	9.59	10.45	11.31	12.17	13.03	13.90	14.76	15.62	16.48
30	8.49	9.32	10.16	10.99	11.82	12.66	13.49	14.32	15.16	15.99
31	8.27	9.07	9.88	10.69	11.49	12.30	13.11	13.91	14.72	15.53
32	8.06	8.84	9.63	10.41	11.19	11.97	12.75	13.53	14.31	15.09
33	7.87	8.62	9.38	10.14	10.90	11.65	12.41	13.17	13.93	14.68
34	7.69	8.42	9.16	9.89	10.63	11.36	12.10	12.83	13.57	14.30
35	7.51	8.23	8.94	9.66	10.37	11.09	11.80	12.51	13.23	13.94

[1] The lint outturns shown in Tables II to VI include the actual lint outturn plus an allowance for bagging and ties.

TABLE III.—*Lint prices per pound, assuming a cottonseed price of $25 per ton.*

Lint outturn.	Seed-cotton price per 100 pounds.									
	$3.25	$3.50	$3.75	$4.00	$4.25	$4.50	$4.75	$5.00	$5.25	$5.50
Per cent.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
27	9.53	10.46	11.39	12.31	13.24	14.16	15.09	16.01	16.94	17.87
28	9.26	10.16	11.05	11.94	12.83	13.73	14.62	15.51	16.41	17.30
29	9.01	9.87	10.73	11.59	12.45	13.32	14.18	15.04	15.90	16.77
30	8.77	9.60	10.44	11.27	12.10	12.94	13.77	14.60	15.44	16.27
31	8.55	9.35	10.16	10.97	11.77	12.58	13.39	14.19	15.00	15.80
32	8.34	9.12	9.90	10.68	11.47	12.25	13.03	13.81	14.59	15.37
33	8.14	8.90	9.66	10.42	11.17	11.93	12.69	13.45	14.20	14.96
34	7.96	8.70	9.43	10.17	10.90	11.64	12.37	13.11	13.84	14.58
35	7.79	8.50	9.22	9.93	10.65	11.36	12.07	12.79	13.50	14.22

TABLE IV.—*Lint prices per pound, assuming a cottonseed price of $30 per ton.*

Lint outturn.	Seed-cotton price per 100 pounds.									
	$3.50	$3.75	$4.00	$4.25	$4.50	$4.75	$5.00	$5.25	$5.50	$5.75
Per cent.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
27	9.82	10.74	11.67	12.60	13.52	14.45	15.37	16.30	17.23	18.15
28	9.55	10.44	11.33	12.23	13.12	14.01	14.90	15.80	16.69	17.58
29	9.29	10.15	11.01	11.87	12.74	13.60	14.46	15.32	16.18	17.05
30	9.05	9.89	10.72	11.55	12.39	13.22	14.05	14.89	15.72	16.55
31	8.83	9.63	10.44	11.25	12.05	12.86	13.66	14.47	15.28	16.08
32	8.62	9.40	10.18	10.96	11.74	12.53	13.31	14.09	14.87	15.65
33	8.42	9.18	9.93	10.69	11.45	12.21	12.97	13.72	14.48	15.24
34	8.24	8.97	9.71	10.44	11.18	11.91	12.65	13.38	14.12	14.85
35	8.06	8.78	9.49	10.21	10.92	11.64	12.35	13.06	13.78	14.49

TABLE V.—*Lint prices per pound, assuming a cottonseed price of $35 per ton.*

Lint outturn.	Seed-cotton price per 100 pounds.									
	$3.75	$4.00	$4.25	$4.50	$4.75	$5.00	$5.25	$5.50	$5.75	$6.00
Per cent.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
27	10.10	11.03	11.96	12.88	13.81	14.73	15.66	16.59	17.51	18.44
28	9.83	10.72	11.62	12.51	13.40	14.29	15.19	16.08	16.97	17.87
29	9.57	10.43	11.29	12.16	13.02	13.88	14.74	15.60	16.47	17.33
30	9.33	10.17	11.00	11.83	12.67	13.50	14.33	15.17	16.00	16.83
31	9.10	9.91	10.72	11.52	12.33	13.14	13.94	14.75	15.56	16.36
32	8.90	9.68	10.46	11.24	12.02	12.80	13.58	14.37	15.15	15.93
33	8.70	9.45	10.21	10.97	11.73	12.48	13.24	14.00	14.76	15.51
34	8.51	9.25	9.98	10.72	11.45	12.19	12.92	13.66	14.39	15.13
35	8.34	9.05	9.77	10.48	11.20	11.91	12.63	13.34	14.05	14.77

TABLE VI.—*Lint prices per pound, assuming a cottonseed price of $40 per ton.*

Lint outturn.	Seed-cotton price per 100 pounds.									
	$3.75	$4.00	$4.25	$4.50	$4.75	$5.00	$5.25	$5.50	$5.75	$6.00
Per cent.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
27	9.46	10.39	11.31	12.24	13.17	14.09	15.02	15.94	16.87	17.80
28	9.22	10.11	11.01	11.90	12.79	13.69	14.58	15.47	16.36	17.26
29	8.99	9.85	10.71	11.58	12.44	13.30	14.16	15.02	15.89	16.75
30	8.78	9.61	10.45	11.28	12.11	12.95	13.78	14.61	15.45	16.28
31	8.58	9.38	10.19	11.00	11.80	12.61	13.42	14.22	15.03	15.84
32	8.39	9.18	9.96	10.74	11.52	12.30	13.08	13.86	14.67	15.42
33	8.22	8.97	9.73	10.49	11.25	12.00	12.76	13.52	14.28	15.03
34	8.05	8.79	9.52	10.26	10.99	11.73	12.46	13.20	13.94	14.67
35	7.90	8.61	9.33	10.04	10.76	11.47	12.19	12.90	13.61	14.33

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CONTENTS.

FARMERS' BULLETIN NO. 751.—PEANUT OIL: Page.
Introduction 1
The manufacture of peanut oil in Europe 2
Varieties of peanuts grown in the United States 4
The preparation of peanuts for oil making 6
Machinery for manufacturing peanut oil 7
Analyses of American-grown peanuts 7
The manufacture of peanut oil in the United States 10
By-products of peanut-oil manufacture 12
Economic considerations in connection with the manufacture of peanut oil 12
Yield of peanuts, cost of production, and returns 13
The proper labeling of peanut products 15
Summary 15

FARMERS' BULLETIN NO. 752.—THE FALL ARMY WORM, OR "GRASS WORM," AND ITS CONTROL:
Introduction 3
General description 3
Where the fall army worm occurs 4
Economic importance and manner of injury 4
Crops attacked 5
Where the invasions of the fall army worm originate 5
When invasions may be expected 6
Life history 6
History of the fall army worm in the United States 9
Natural enemies 9
Control measures 12

FARMERS' BULLETIN NO. 753.—COMMERCIAL HANDLING, GRADING, AND MARKETING OF POTATOES:
Introduction 1
Handling southern early, or "new," potatoes 2
Handling northern late potatoes 10
Need of standardization 18
Improvement through cooperative organizations 22
Containers 23
Brands 26
Marking packages of potatoes to show quantity of contents 26
Loading cars 26
Marketing 29
Railroad billing 36
Shrinkage 38
Weighing 39
Summary 39

FARMERS' BULLETIN NO. 754.—THE BEDBUG:

Page.
Introduction 1
Origin, common names, distribution 2
Varieties and related insects 3
General characteristics 3
The "buggy" odor 4
Habits and life history 4
Food and longevity 7
Influence of temperature 8
The bite of the bedbug 9
The bedbug and human diseases 9
Natural enemies of the bedbug 10
Remedies 11

FARMERS' BULLETIN NO. 755.—COMMON BIRDS OF SOUTHEASTERN UNITED STATES IN RELATION TO AGRICULTURE:

Introduction 1
House wren 5
Carolina wren 7
Mocking bird 9
Brown thrasher 11
Cardinal 13
Gray grosbeak 14
Painted bunting 15
Common crow 17
Blue jay 18
Meadow lark 19
Boat-tailed grackle 22
Bluebird 23
Carolina chickadee 24
Tufted titmouse 26
Purple martin 28
Scissor-tailed flycatcher 29
Red-cockaded woodpecker 31
Chuck-will's-widow 32
Nighthawk 33
Yellow-billed cuckoo 34
Bob-white 36
Swallow-tailed kite 37
Turkey buzzard 37

FARMERS' BULLETIN NO. 756.—CULTURE OF RYE IN THE EASTERN HALF OF THE UNITED STATES:

Introduction 1
Rye varieties 3
Production of the rye crop 5
Harvesting the crop 13
Pests 14

FARMERS' BULLETIN NO. 757.—COMMERCIAL VARIETIES OF ALFALFA:

Introduction 1
The common alfalfa group 3
Turkestan group 7
Variegated group 8
Nonhardy group 14
Yellow-flowered group 17
Varieties or strains for various sections 20

FARMERS' BULLETIN No. 757—Continued. Page.
Purchasing seed 22
Seed production 23
Possibilities in breeding 23
Summary 23

FARMERS' BULLETIN No. 758.—MUSCADINE GRAPE SIRUP:
Introduction 1
Varieties 3
Picking 3
Crushing 3
Pressing 4
Making the sirup 7
Comments and suggestions 9
Summary 11

FARMERS' BULLETIN No. 759.—"WHITE ANTS" AS PESTS IN THE UNITED STATES AND METHODS OF PREVENTING THEIR DAMAGE:
Introduction 1
Description and habits of white ants 2
Life cycle of white ants 4
The swarm 4
Damage to woodwork of buildings and to other timber 5
Damage to stored material 8
Damage to fruit, nut, shade, and forest trees 9
Damage to field crops and grazing land 10
Damage to nursery stock, young plantation stock, and vineyards 11
Damage to shrubs, flowers, and greenhouse stock 12
Protection of woodwork in buildings 12
Protection of stored material 17
Protection of live trees 18
Protection of nursery stock, vineyards, and field crops 18
Protection of flowers and greenhouse stock 18
Summarized recommendations for protection of woodwork in buildings 19

FARMERS' BULLETIN No. 760.—HOW TO ATTRACT BIRDS IN NORTHWESTERN UNITED STATES:
Introduction 1
Protection 2
Breeding places 2
Water supply 3
Food 4
Protecting cultivated fruit 11

FARMERS' BULLETIN No. 761.—MANAGEMENT OF MUCK-LAND FARMS IN NORTHERN INDIANA AND SOUTHERN MICHIGAN:
Introduction 1
Summary 2
Types of farming 3
Intensive and extensive crops 4
Development and management of muck land 21

FARMERS' BULLETIN No. 762.—THE FALSE CHINCH BUG AND MEASURES FOR CONTROLLING IT:
Introduction 1
Generations and food habits 2
Control measures 2

FARMERS' BULLETIN NO. 763.—ORCHARD BARKBEETLES AND PINHOLE BORERS, AND HOW TO CONTROL THEM:

Page.
Introduction 1
Nature of injury caused by shot-hole and pinhole borers 2
The fruit-tree barkbeetle 3
The peach-tree barkbeetle 6
Control of the fruit-tree and peach-tree barkbeetles 9
The apple wood-stainer 13
The pear-blight beetle 14

FARMERS' BULLETIN NO. 764.—COTTON GINNING INFORMATION FOR FARMERS:

Separation of seed for planting 3
Ginner's certificate for the farmer 4
Usual ginning process 6
One and two story gins 7
General discussion of the principal parts of gin machinery 8
Plated bales 20
Careless preparation of the American bale of cotton 23
Conclusions 26

FARMER'S BULLETIN NO. 765.—BREEDS OF SWINE:

Choosing a breed 3
Classification of swine 3
The lard type of hog 4
The bacon type of hog 12
Minor breeds of hogs 14

FARMERS' BULETIN NO. 766.—THE COMMON CABBAGE WORM:

Introduction 1
Descriptive 1
Nature of injury 3
Origin, spread, and present distribution 5
Food habits 7
Life history 7
Natural enemies 8
Methods of control 10
Summary 13

FARMERS' BULLETIN NO. 767.—GOOSE RAISING:

Goose production 3
Breeds 3
Goose breeding 7
Feeding geese and goslings 12
Preparing for market 13
Reports from breeders 14

FARMERS' BULLETIN NO. 768.—DWARF BROOM CORNS:

Introduction 1
Climatic adaptation of broom corn 1
Varieties 2
Growing the crop 3
Preparing for market 12
Diseases 14
Profit and loss 14

FARMERS' BULLETIN NO. 769.—GROWING GRAIN ON SOUTHERN IDAHO DRY FARMS:

Page.
Introduction 3
The Snake River Basin 4
Dry-farming machinery 6
Good seed 13
Seed-bed preparation 14
Cereal crops 16

FARMERS' BULLETIN NO. 770.—CANARIES: THEIR CARE AND MANAGEMENT:

Introduction 3
History 4
Varieties 5
Cages 7
Care of cages 9
Food 10
Bathing 11
Molt 11
Color feeding 12
Breeding 14
Sex and age 16
Vermin 17
Care of feet and bill 18
Broken limbs 19
Loss of feathers about head 19
Diseases 19

FARMERS' BULLETIN NO. 771.—HOMEMADE FIRELESS COOKERS AND THEIR USE:

Introduction 3
How to make a homemade fireless cooker 4
How to use the fireless cooker 9
Recipes for use with the fireless cooker 11

FARMERS' BULLETIN NO. 772.—CONTROL OF THE SUGAR-BEET NEMATODE:

Description and life history of the sugar-beet nematode 3
The beet nematode in Europe 6
The beet nematode in the United States 7
Effects of beet-nematode attacks 7
Differences between the beet nematode and the root-knot nematode 10
Conditions favorable to the beet nematode 11
Methods of spreading the pest 12
Plants subject to attack by beet nematodes 13
Plants not subject to attack 14
Ineffective methods of combating the nematode 15
How to fight the beet nematode 15
Crops available for rotation on infested land 17
Preventing the further introduction of the beet nematode 18
Breeding or selecting resistant beets 18
Summary 18

FARMERS' BULLETIN NO. 773.—CORN GROWING UNDER DROUGHTY CONDITIONS:

Introduction 3
Why corn growing is attempted in semiarid regions 4
Corn not naturally adapted to semiarid regions 5

FARMERS' BULLETIN No. 773—Continued. Page.

Some essentials of corn production 7
Getting moisture into the soil 8
Preparing land for planting 10
Time of planting 12
Methods of planting 14
Cultivation 16
Corn growing under irrigation 18
Animal and insect enemies 20
Principles governing the choice of varieties 21
Need of good sources of seed corn 22
Pasturing corn 23
Conclusions 24

FARMERS' BULLETIN No. 774.—GAME LAWS FOR 1916: A SUMMARY OF THE PROVISIONS RELATING TO SEASONS, EXPORT, SALE, LIMITS, AND LICENSES:

Introduction 1
Review of legislation of 1916 2
New laws passed in 1916 7
Regulations for the protection of migratory birds 13
Treaty for the protection of migratory birds 18
Open seasons 21
Shipment of game 36
Sale of game 43
Disposition of game raised in captivity 48
Limits 50
Minimum age limits for hunting 53
Licenses for hunting game 54
Officials from whom State or Provincial game laws may be obtained 63

FARMERS' BULLETIN No. 775.—LOSSES FROM SELLING COTTON IN THE SEED:

Reasons why cotton is sold in the seed 2
Disadvantages of selling cotton in the seed 2
Difficulty of determining a just seed-cotton price 3
Ginned cotton brings higher prices than unginned cotton 4
Inconsistencies in prices received for lint content of seed cotton 5
Recommendations 6
Prices resulting from different lint percentages 7

INDEX.

	Farmers' Bulletin No.	Page.
Aberdeen Branch experiment farm, Idaho, establishment and maintenance	769	4
Acid lands, rye growing, advantages	756	8
Acme broom corn, description and value	768	3
African goose, description and value	767	5
African peanut, description, value, and composition	751	5, 9
Agriculture, Southeastern United States, relation of birds, bulletin by F. E. L. Beal, W. L. McAtee, and E. R. Kalbach	755	1–40
AICHER, L. C., bulletin on "Growing grain on southern Idaho dry farms"	769	1–23
Alabama, game laws, 1916	774	22, 38, 44, 50, 57, 63
Alaska, game—		
laws, 1916	774	7–8, 22, 38, 44, 50, 57, 63
legislation, 1916	774	7–8
Alberta, game laws, 1916	774	33, 42, 47, 53, 54, 61, 64
Alfalfa—		
breeding, possibilities	757	23
commercial varieties, bulletin by R. A. Oakley and H. L. Westover	757	1–24
common—		
characteristics and value of different strains	757	3–7
use of term	757	3
domestic strains, qualities and value	757	4–6
introduction into United States	757	3
seed—		
production, notes	757	23
purchasers, suggestions	757	22–23
Spanish, receipts, suggestions to growers	757	7
strains for different sections, recommendations	757	20–22
varieties, characteristics, comparison with other varieties	757	14–17
worm. *See* Army worm, fall.		
yellow-flowered—		
group, characteristics, comparison with other varieties	757	17–20
introduction into United States	757	17–20
Alfalfas, groups, descriptions	757	2
Ambrosia beetle, description and injury to fruit trees	763	3
Ambush bug, enemy of cabbage worm	766	9
Angoumois grain moth, enemy of rye	756	15
Anisandrus pyri, description, occurrence, habits, and remedies	763	14–15
Ant—		
little red, enemy of bedbugs, instances	754	10
white, life cycle	759	4
Anthracnose, rye disease	756	16
Antrostomus carolinensis, description, habits, and destruction of insects	755	32–33

	Farmers' Bulletin No.	Page.
Ants—		
damage to growing plants	759	9–12
white—		
damage to stored products	759	8
damage to timbers, woodwork in buildings, etc	759	5–8
description and habits	759	2–3
pest in United States and methods for preventing damage, bulletin by T. E. Snyder	759	1–20
preventive and remedial measures	759	12–20
swarming habits	759	4–5
Apple wood-stainer, description, occurrence, and habits	763	13–14
Apples, marketing under State apple-grading law, advantages	753	19
Archytas piliventris, enemy of fall army worm	752	11
Arid lands, corn growing	773	1–24
Arizona, game laws, 1916	774	22, 38, 44, 50, 55, 57, 63
Arkansas, game laws, 1916	774	22, 38, 44, 48, 50, 56, 57, 63
Army worm—		
destruction by bird enemies, note	755	4
fall—		
and its control, bulletin by W. R. Walton and Philip Luginbill	752	1–16
crops attacked, manner and season of invasions	752	5–6
description, occurrence, and nature of injury	752	3–6
economic importance	752	4–5
enemies and control measures	752	9–14
history and habits	752	6–9
influence of weather conditions	752	6
outbreaks, historical notes	752	9
similarity to true army worm	752	7–8
Arsenate, lead—		
use against cabbage worms	766	11
use against fall army worm	752	5
Arsenic, white, application to plants, caution	752	14
Arsenicals, use against cabbage worms	766	10–12
Arsenite, zinc, use against fall army worm	752	5
Ashbrook, F. G., bulletin on "Breeds of swine"	765	1–16
Atkinson, C. E., Fred Taylor, and D. C. Griffith, bulletin on "Cotton-ginning information for farmers"	764	1–28
Bacon breeds, hogs, descriptions and value	765	12–14
Bæolophus bicolor, description, habits, and destruction of insects	755	26–28
Bag limits, game legislation, 1916	774	6
Bailey, H. S., and H. C. Thompson, bulletin on "Peanut oil"	751	1–16
Bait, poison-bran, use against fall army worm	752	14
Baltic alfalfa, characteristics and value	757	11–12
Bancroft, W. F., T. S. Palmer, and Frank L. Earnshaw, bulletin on "Game laws for 1916: A summary of the provisions relating to seasons, export, sale, limits, and licenses"	774	1–64
Bark beetles, orchard, and pinhole borers, and how to control them, bulletin by Fred E. Brooks	763	1–16
Barley, growing on dry lands, Idaho, varieties and methods	769	22
Barn-swallow bug, occurrence as house pest	754	3
Beal, F. E. L., W. L. McAtee, and E. R. Kalmbach, bulletin on "Common birds of Southeastern United States in relation to agriculture"	755	1–40
"Bearded roots," beets, cause and appearance	772	8
Bedbug—		
bite, effect and treatment	754	9
bulletin by C. L. Marlatt	754	1–12

	Farmers' Bulletin No.	Page.
Bedbug—Continued.		
enemies and control measures	754	10–12
food and longevity	754	7–8
historical notes	754	2
influence of temperature	754	8–9
life history and habits	754	4–7
occurrence and distribution	754	1–3
transmission of diseases	754	9–10
varieties, characteristics, and habits	754	3–7
Bedbugs, remedies, formulas and application	754	1–12
Beet—		
industry, menace from eelworm	772	7
nematodes, plants subject to attack, list	772	13–14
seed, treatment for eelworm	772	18
"weariness" of soil, cause, note	772	6
Beetle, ambrosia, description and injury to fruit trees	763	3
Beetles, orchard. *See* Bark beetles, orchard.		
Beets—		
breeding or selection	772	18
eelworm-infested, nature of injury	772	7–10
sugar, eelworm control	772	1–19
Berkshire hog—		
description and value	765	6–7
origin, fecundity, and quality of pork	765	6–7
record associations, location and secretary	765	6
Billbugs, destruction by bird enemies	775	3
Binders, use and value in harvesting dry-land crops	769	10
Bird—		
houses, construction, suggestions	760	7–8
louse, gray, control on canaries	770	17
seed, selection for canaries	770	10–11, 12, 13
Birds—		
attraction to homestead, northwestern United States, bulletin by W. L. McAtee	760	1–12
canaries, their care and management, bulletin by Alexander Wetmore	770	1–20
enemies—		
of cabbage worm	766	9
of fall army worm	752	12
feeding, methods and suggestions	760	4–11
food, publications relating to, list	755	40
lamed, treatment of canaries	770	12
migratory—		
protection, proclamation by President	774	13–17
protection, treaty between United States and Great Britain	774	18–20
nesting—		
habits of some common species	755	5, 7, 11, 13, 15–16, 20, 23, 24–25, 26, 28, 29, 33, 36, 38
places, attraction to homestead, suggestions	760	2–3
protection methods, note	760	2
publications of Department relating to foods	755	40
publications relating to, list	760	12
song, Southeastern United States	755	7, 9, 11, 13, 14, 15
Southeastern United States, relation to agriculture, bulletin by F. E. L. Beal, W. L. McAtee, and E. R. Kalbach	755	1–40
use in destruction of harmful insects, descriptions and value	755	2–37
water supply, suggestions	760	3–4

	Farmers' Bulletin No.	Page.
Black hog—		
large type—		
description, and value of pork	765	16
record association and address of secretary	765	16
Suffolk hog. *See* Essex hog.		
Blackbird, boat-tailed grackle, description, habits, and destruction of insects	755	22–23
Blue jay, description, habits, and destruction of insects	775	18–19
Bluebird, description, habits, and destruction of insects	755	23–24
Boars, size and potency of standard breeds	765	6, 7, 9, 10, 12, 13, 14, 16
Bob-white—		
description, habits, and destruction of insects	755	36–37
destruction of chinch bug	755	4
Boll weevil—		
destruction by bird enemies	755	2
district, peanut growing, increase, note	751	1
Bollworm, destruction by bird enemies	755	3
Borers, orchard pinhole, and barkbeetles, and how to control them, bulletin by Fred E. Brooks	763	1–16
Brands, potato marketing, importance	753	26
Breads, cooking by fireless cooker	771	16
Breakfast foods, cereals, cooking by fireless cooker	771	13
Breeding—		
cages, canary, requirements and suggestions	770	8–9
canary, management and care of young	770	14–16
geese, equipment, practices and suggestions	767	7–12
Breeds, swine, bulletin by F. G. Ashbrook	765	1–16
British Columbia, game—		
laws, 1916	774	11, 34, 42, 47, 52, 61, 64
legislation 1916	774	11
BROOKS, FRED R., bulletin on "Orchard barkbeetles and pinhole borers, and how to control them"	763	1–16
Broom corn—		
acreage and distribution	768	2
climatic requirements and varieties	768	1–3
diseases	768	14
grading, baling, and storage	768	12–13
growing, seed selection, sowing, and cultivation	768	3–8
harvesting, thrashing, and curing	768	8–12
production, cost, and market value	768	14–15
seed, hybridized, objections	768	5
yields by States	768	15–16
Broom corns—		
bulletin by Benton E. Rothgeb	768	1–16
dwarf, bulletin by Benton E. Rothgeb	768	1–16
Brown thrasher—		
description, habits, and destruction of insects	755	11–13
destruction of chinch bug	755	4
Buildings, construction to prevent white-ant infestation	759	12–14
Bull-bat, description, habits, and destruction of insects	755	33–34
Bunt, control treatment of seed wheat	769	14
Bunting, painted, description, habits, and destruction of insects	755	15–16
Buzzard—		
abundance in South, note	755	38–39
turkey—		
description, habits, and economic value	755	37–39
factor in spread of diseases	755	38–39
By-products, peanut-oil mills, character and value	751	12
Cabbage—		
butterfly, imported, description and life history	766	1–3
crops, losses from cabbage worm	766	5

	Farmers' Bulletin No.	Page.
Cabbage—Continued.		
growing on muck land, labor value, by acre and by day	761	6
worm—		
common, bulletin by F. H. Chittenden	766	1–16
control methods	766	10–13
description, habits, and nature of injury	766	1–5
food habits	766	7
hot-water remedy	766	12
life history and enemies	766	7–9
origin, spread, and distribution	766	5–7
Cabbages, defoliation by cabbage worm, description	766	3–5
Cages, canary, care and equipment	770	7–9
Calcium carbonate, use in manufacture of muscadine grape sirup	758	7, 9–10
California, game laws, 1916	774	23, 38, 45, 48, 55, 57, 63
Canada—		
game laws, 1916	774	4, 6, 7, 11–12, 18–20, 33–36, 42–43, 47–48, 53, 54–55, 61–62, 64
goose, description and value	767	6–7
Canadian variegated alfalfa, characteristics and value	757	12–13
Canaries—		
color, feeding for	770	12–14
diseases, and treatment	770	19
domestication, historical notes	770	3–5
importations, number and sources	770	3
lamed, treatment	770	19
sex and age, determination	770	16–17
song, mating, rearing, and training	770	5–7
their care and management, bulletin by Alexander Wetmore	770	1–20
varieties, descriptions	770	5–7
Canary—		
cages, requirements and suggestions	770	7–9
food, selection and preparation	770	10
Mexican, description, habits, and destruction of insects	755	15–16
mite, description and control	770	17–18
molting, treatment	770	11–12
parasites, descriptions and control	770	17–18
wild, range, description, and habits	770	4–5
Carbon bisulphid, liquid, treatment of soil for white ants	759	18–19
Cardinal, description, habits, and destruction of insects	755	13–14
Cardinalis cardinalis, description, habits, and destruction of insects	755	13–14
Carolina—		
chickadee, description, habits, and destruction of insects	755	24–26
wren, description, habits, and destruction of insects	755	7–9
Cars, potato, loading methods	753	26–29
Catharista urubu, description, habits, and economic value	755	38
Cathartes aura septentrionalis. *See* Buzzard.		
Celery—		
farming, muck lands, Michigan, acreage, labor, associated crops, etc	761	8–9
growing on muck land, labor value by acre and by day	761	6
"Celery-root," beets, cause and appearance	772	8
Cereal—		
breakfast foods, by fireless cooker	771	13
crops, damage from fall army worm	752	5
Chalcis fly, parasite of cabbage worm	766	8–9
Chelonus texanus, description, enemy of fall army worm	752	10

	Farmers' Bulletin No.	Page.
Cheshire hog—		
origin, description, and quality of pork	765	15
record association, and address of secretary	765	15
Chester White hog—		
origin, fecundity, and quality of pork	765	9–10
record associations, location, and secretaries	765	10
Chickadee, Carolina, description, habits, and destruction of insects	755	24–26
Chicken—		
browned fricassee, cooking by fireless cooker	771	14
creole, recipe for fireless cooker	771	11
"Chinch." *See* Bedbug.		
Chinch bug—		
destruction by bird enemies	755	4
false—		
and measures for controlling it, bulletin by F. B. Milliken	762	1–4
description, occurrence, and life history	762	1–4
destruction and control measures	762	2–4
food plants	762	2
Chinese goose, description and value	767	6
"Chintz." *See* Bedbug.		
CHITTENDEN, F. H., bulletin on "The common cabbage worm"	766	1–16
Chordeiles virginianus, description, habits, and destruction of insects	755	33–34
Chuck-will's-widow, description, habits, and destruction of insects	755	32–33
Chyropachys colon, parasite of bark beetle, note	763	6
Cimex—		
Haematosiphon inodora, poultry pest	754	3
hemipterus, occurrence as pest	754	3
lectularius. *See* Bedbug.		
Oeciacus hirundinis, occurrence as pest	754	3
Clearing, muck land	761	22
Click beetles, destruction by bird enemies	755	3
Clover insects, destruction by birds	755	4–5
Coccyzus americanus, description, habits, and destruction of insects	755	34–36
Colinus virginianus, description, habits, and destruction of insects	755	36–37
Color, canaries, feeding for	770	12–14
Colorado—		
false chinch bug, occurrence	762	1
game laws, 1916	774	23, 38, 45, 48, 50, 55, 57, 63
Connecticut, game laws, 1916	774	23, 38, 45, 48, 50, 54, 56, 57, 63
Containers, standard, for potatoes, types and needs	753	23–26
Cooker, fireless—		
equipment and management	771	4–11
packing material, caution	771	7–9
Cookers, homemade fireless, construction and uses	771	3–16
Cooking, fireless, equipment, advantages, and management	771	9–19
Cooperation, potato marketing, advantages	753	22–23
Coreus brachyrhynchos. *See* Crow.		
Corn—		
crop, enemies, control measures	773	20–21
destruction by birds	755	18, 19, 20, 23
early planting on dry lands, advantages	773	13
frozen back, development and yield	773	13

	Farmers' Bulletin No.	Page.
Corn—Continued.		
growing—		
climatic requirements	773	7–8
irrigation, principles and suggestions	773	18–20
on muck land, labor value by acre and by day	761	6
under droughty conditions, bulletin by C. P. Hartley and L. L. Zook	773	1–24
insects, destruction by birds	755	3, 4
pasturing, practices and advantages	773	23
planting and cultivation, dry lands	773	14–16
plants—		
damage by fall army worms	752	13
injury by white ants	759	10–11
production, essentials	773	7–8
varieties for semiarid regions, selection	773	21–22
Corn-ear worm, destruction by bird enemies	755	3
Cotton—		
bale, dimensions, note	764	7
bales—		
American, careless preparation, practices, and objections	764	23–26
plated, practices at gins, objections	764	21
boll weevil. *See* Boll weevil.		
ginning, information for farmers, bulletin by Fred Taylor,		----
D. C. Griffith, and C. E. Atkinson	764	1–28
lint, prices, comparison with seed-cotton prices	775	4–8
publications, list	764	28
seed. *See* Seed-cotton.		
selling in seed—		
causes and disadvantages	775	2–3
losses from, bulletin by Charles F. Cresswell	775	1–8
variety for community, selection, importance	764	4
worm, destruction by bird enemies	755	3
Cottonseed—		
ginning for planting, care and directions	764	3–4
oil mill, equipment for peanut oil, requirements	751	7, 11–12
selection for planting	764	3
yield and prices per bale of lint	775	4–5
Cover crop, rye—		
advantages	756	8
value	756	8
Creole soup, recipe for fireless cooking	771	21
Cresswell, Chares F., bulletin on "Losses from selling cotton in the seed"	775	1–8
Crop, rye, intertilled	756	8
Crops—		
intensive, labor requirement, comparison with extensive crops	761	4–6
rotation, sugar-beet eelworm control	772	16–17
Crow—		
description, habits, and destruction of insects	755	17–18
disease carrier, note	755	18
garden pest	755	18
Crucifers, damage by cabbage worms	766	7
Cuckoo—		
cotton-worm destruction	755	3
yellow-billed, description, habits, and destruction of insects	755	34–36
Curing broom corn, methods	768	10–12
Cutworms—		
destruction by bird enemies	755	4
poison bait, preparation and use	773	21
Cyanocitta cristata, description, habits, and destruction of insects	755	18–19
"Daggy's corn worm." *See* Army worm, fall.		
Dearing, Charles, bulletin on "Muscadine grape sirup"	758	1–11

	Farmers' Bulletin No.	Page.
Delaware, game laws, 1916	774	23,38, 45,50,55 –57,63
Dinner, boiled, cooking by fireless cooker	771	15
District of Columbia, game laws, 1916	774	23–24, 50, 63
DORLAND, C. R., and C. T. MORE, bulletin on "Commercial handling, grading, and marketing of potatoes"	753	1–40
Drainage, muck land, methods	761	22–23
Dried vegetables and fruits, cooking by fireless cooker	771	15–16
Drill, rye, for sowing between rows of standing crops	756	12
Dry farming, growing grain in southern Idaho, bulletin by L. C. Aicher	769	1–23
Dry lands—		
corn growing, advantages	773	4–5
corn growing under droughty conditions	773	1–24
Dry-land—		
crops, southern Idaho	769	4
experiment station, Aberdeen, Idaho, establishment and maintenance	769	19–20
Dryobates borealis, description, habits, and destruction of insects	755	31–32
Duroc-Jersey hog—		
description and value	765	7–9
origin, fecundity and quality of pork	765	7–9
record associations, location and secretaries	765	9
Dwarf broom corn, description and uses	768	3
EARNSHAW, FRANK L., T. S. PALMER, and W. F. BANCROFT, bulletin on "Game laws for 1916: A summary of the provisions relating to seasons, export, sale, limits, and licenses"	774	1–64
Eelworm—		
brown-cyst stage, description and importance in spread	772	5–6, 18
sugar-beet—		
combating, methods	772	15–17
control, bulletin by Harry B. Shaw	772	1–19
description and life history	772	3–6
effect on foliage and yield	772	9–10
growth and spread, conditions favorable	772	11–13
nature of injury	772	7–10
occurrence and economic importance	772	3
spread in Europe and United States	772	6–7
spread in United States, means and extent	772	7, 12–13
Egyptian goose, description and value	767	7
Elanoides fortificatus, description, habits, and destruction of insects	755	37
Embden goose, description and value	767	4–5
Emmer, growing on dry lands, Idaho, note	769	22–23
Ergot, rye disease—		
nature	756	16
nature and treatment	856	16
Essex hog—		
origin, description, and value of pork	765	15
record association and address of secretary	765	15
Europe—		
peanut oil, manufacture and use	751	2–4
sugar-beet eelworm, occurrence and spread	772	6
Exports, game, legislation, 1916	774	5
False chinch bug—		
and measures for control, bulletin by F. B. Milliken	762	1–4
See also Chinch bug, false.		
Farmer, losses from fall army worm, suggestions	752	12–13
Farmers, cotton-ginning information, bulletin by Fred Taylor, D. C. Griffith, and C. E. Atkinson	764	1–28

	Farmers' Bulletin No.	Page.
Farming—		
dry, growing grain in southern Idaho, bulletin by L. C. Aicher	769	1–23
intensive, labor requirements, comparison with extensive type	761	4–6
types on muck land, Indiana and Michigan	761	3–26
Farms, muck-land, management in northern Indiana and southern Michigan, bulletin by H. R. Smalley	761	1–26
Feathers—		
goose, demand, notes	767	3, 8
goose, production, prices and care	767	14
Feeding—		
canary, management	770	10–11, 12–14
geese and goslings	767	12–13
Fence, vermin-proof, for birds	760	2
Fertilizers, rye	756	9–10
Finch—		
description, habits, and destruction of insects	755	15–16
serin, similarity to canary	770	4
Fireless cooker, advantages	771	3–4
Fishing, licenses, laws on, 1916	774	55
Flax, growing on dry lands, Idaho, note	769	23
Florida—		
game laws, 1916	774	24, 38, 45, 50, 51, 63
potato crop, harvesting, handling, and marketing	753	2–5
Flowers—		
damage by white ant	759	12
protection from white ants	759	18–19
Flycatcher, scissor-tail, description, habits, and destruction of insects	755	29–31
Food oil, peanut, economic importance	751	2
Forage crops, damage from fall army worm, note	752	5
Fowl, tough, cooking recipe for fireless cooker	771	14, 15
Fricassee chicken, cooking by fireless cooker	771	14
Fruit trees—		
barkbeetle—		
control measures	763	9–13
description, life history, and habits	763	3–6
enemies and control	763	6, 9–13
injury, history, and occurrence	763	2–3
pruning for barkbeetle control	763	9–12
Fruits—		
attraction to birds, list with seasons	760	9–11
deciduous, insects injurious to, list of department publications	763	16
dried, cooking by fireless cooker	771	16
protection from birds	760	11
Game—		
big, legislation, 1916	774	3–5
export, legislation, 1916	774	5
laws—		
1916, bulletin by T. S. Palmer, W. F. Bancroft and Frank L. Earnshaw	774	1–64
Federal, 1916	774	7, 13–22, 36–37
officials, addresses, by States and Provinces	774	63–64
open seasons—		
legislation, 1916	774	5
United States and Canada, by States and Provinces	774	21–36
raising in captivity, disposition, laws, by States and Provinces	774	48–50
refuges and preserves, legislation, 1916	774	6–7

	Farmers' Bulletin No.	Page.
Game—Continued.		
sale—		
laws by States and Provinces	774	43–48
legislation, 1916	774	5
shipment, laws prohibiting, by States and Provinces	774	36–43
Garlic, wild, pest of rye fields	756	14–15
Gasoline torch, use against false chinch bug, directions and value	762	2–3
Geese—		
egg production	767	15, 16
feeding	767	12–13
picking, practices, and suggestions	767	14
preparation for market	767	13–14
standard breeds, descriptions and value	767	1–7
Georgia, game—		
laws, 1916	774	8, 24, 38, 45, 51, 57, 63
legislation, 1916	774	
Gin, machinery, description and discussion	764	8–21
Ginner, certificates to farmer	764	4–6
Ginning—		
cotton, information for farmers, bulletin by Fred Taylor, D. C. Griffith, and C. E. Atkinson	764	1–28
processes	764	6–7
Gins, cotton, different types, advantages	764	7
Goose—		
eggs, hatching, practices and suggestions	767	10–12
flesh, nature and demand	767	3
industry—		
reports from breeders	767	14–16
South, comparison with North	767	15–16
status, production and demand	767	1
picking, suggestions	767	14
raising, bulletin by Harry M. Lamon and Alfred R. Lee	767	1–16
yield of feathers per year	767	14
Gophers, poison bait, preparation and use	773	21
Goslings, management	767	10–13
Grackle—		
boat-tailed, damage to rice crops	755	22
boat-tailed, description, habits, and destruction of insects	755	22–23
Grading machines—		
for sizing potatoes, description, advantages, etc	753	2–3, 12–14
potato, description, advantages, etc	753	2–3, 12–14
Grading potatoes—		
commercial, handling, marketing, etc., bulletin by C. T. More and C. R. Dorland	753	1–40
methods and practices	753	15–18
Grain—		
crops, injury by white ants	759	10
farming, muck lands, Indiana and Michigan, area, yields, and suggestions	761	12–14
growing on southern Idaho dry farms, bulletin by L. C. Aicher	769	1–23
Granary weevil, rye enemy	756	15
Grape—		
juice, yield of muscadine grape	758	6
sirup, muscadine, bulletin by Charles Dearing	758	1–11
"Grass army worm." *See* Army worm, fall.		
"Grass worm"—		
nature and control, bulletin by W. R. Walton and Philip Luginbill	752	1–16
See also Army worm, fall.		
Great Britain, treaty with United States for protection of migratory birds	774	18–20

	Farmers' Bulletin No.	Page.
Green manure crop, rye, value	756	8
Greenhouse stock—		
damage by white ants	759	12
protection from white ants	759	18–19
Griffith, D. C., Fred Taylor, and C. E. Atkinson, bulletin on "Cotton ginning information for farmers"	764	1–28
Grimm alfalfa, characteristics and value	757	10–11
Grosbeak, gray, description, habits and destruction of insects	755	14–15
Ground squirrels, poison baits, preparation and use	773	21
"Hairy root," beets, cause and appearance	772	8
Hamitermes tubiformans. See Ant, white.		
Hampshire hog—		
description and value	765	10–12
origin, fecundity and quality of pork	765	10–12
record association, location and secretary	765	12
Harrows, dry-land, requirements and descriptions	769	8–9
Hartley, C. P., and L. L. Zook, bulletin on "Corn growing under droughty conditions"	773	1–24
Harvesters, types for dry-land crops	769	10–13
Harvesting—		
broom corn, methods and importance	768	8–9
machinery, dry-land farming, requirements and description	769	10–13
potatoes, methods in different States	753	2, 5, 6, 10–12
rye, methods	756	13–14
Hay, growing on muck land, labor value by acre and by day	761	6
Header, use and value in harvesting dry-land crops	769	10
Heterodera—		
radicicola, injury to sugar beet, comparison with effect of sugar-beet eelworm	772	10
schachtii. See Eelworm, sugar-beet.		
Hogs—		
bacon type, descriptions and value	765	12–14
breeds, bulletin by F. G. Ashbrook	765	1–16
lard types, breeds, descriptions and value	765	4–12
market demands, sizes	765	4
standard, record associations, location, and secretaries	765	6, 7, 9, 10, 12, 13, 14, 15–16
types, advantages	765	3–4
Homestead, attraction of birds, Northwestern United States, bulletin by W. L. McAtee	760	1–12
Homing grits, cooking by fireless cooker, recipe	771	11
Horseflies, destruction by birds	755	5
House wren, description, habits, and value to homestead	755	5–7
"Hunger roots" beets, cause and appearance	772	8
Hunting—		
licenses—		
laws by States and Provinces	774	54–62
legislation, 1916	774	6
limit of age, by States and Provinces	774	53–54
open seasons, legislation, 1916	774	5
Hydrocyanic-acid gas, use against bedbugs	754	11
Ichneumon fly, parasite of cabbage worm	766	8
Idaho—		
game laws, 1916	774	24, 38, 45, 50, 51, 57, 63
southern, grain growing on dry farms, bulletin by L. C. Aicher	769	1–23

	Farmers' Bulletin No.	Page.
Illinois, game laws, 1916	774	24, 38, 45, 48, 50, 56, 57, 63
Incubation, goose-egg, practices and suggestions	767	10–12
Indiana—		
game laws, 1916	774	24, 38, 45, 50, 55–57, 63
northern, muck-land farms, management (and in southern Michigan), bulletin by H. R. Smalley	761	1–26
Inspection, potatoes, work of growers' cooperative association	753	7–9
Insect pests, "buggy" odor, discussion	754	4
Insecticides, use against fall army worm	752	13–14
Insects—		
deciduous fruit, publications relating to, list	763	16
harmful, destruction by bird enemies	755	2–37
truck crop, publications of Department, list	766	15–16
Intertilled crop, rye, advantages	756	8
Iowa, game laws, 1916	774	25, 38, 45, 48, 50, 54, 57, 63
Irish cobbler potato, production in South Carolina and Virginia, handling, marketing, etc	753	5–10
Irrigation, corn growing, requirements	773	18–20
Jay, blue, description, habits, and destruction of insects	755	18–19
Jaybird, description, habits, and destruction of insects	755	18–19
KALMBACH, E. R., F. E. L. BEAL, and W. L. MCATEE, bulletin on "Common birds of southeastern United States in relation to agriculture"	755	1–40
Kansas—		
corn yield, dry and wet seasons, comparison	773	8
false chinch bug, occurrence and damage	762	1–2
game laws, 1916	774	25, 38, 45, 48, 51, 58, 63
Kentucky—		
game laws, 1916	774	8, 38, 45, 48, 51, 58, 63
game legislation, 1916	774	8
Kerosene emulsion—		
formula	759	19
use against white ants	759	19
Kerosene, use against white ants	759	16, 19
Kite, swallow-tailed, description, habits, and destruction of insects	755	37
Knapweed, Russian, occurrence in Turkestan alfalfa seed	757	8
Labor—		
income and cost, muck farming in Indiana and Michigan	761	16–18
muck-land farming, value per acre and per day	761	6
LAMON, HARRY M., and ALFRED R. LEE, bulletin on "Goose raising"	767	1–16
Lancashire canary, description	770	7
Lark—		
field, description, habits, and destruction of insects	755	18–19
meadow, description, habits, and destruction of insects	755	19–21
Laphygma frugiperda. *See* Army worm, fall.		

Farmers' Bulletin No. — Page.

Laws, game—
  1916, bulletin by T. S. Palmer, W. F. Bancroft, and Frank L. Earnshaw — 774 — 1–64
  new, for 1916, Federal and State — 774 — 7–11
Lead arsenate—
  use against cabbage worms — 766 — 11
  use against fall army worm — 752 — 5
Lee, Alfred R., and Harry M. Lamon, bulletin on "Goose raising" — 767 — 1–16
Legislation, game, 1916, review — 774 — 2–7
Leighty, Clyde E., bulletin on "Culture of rye in the eastern half of the United States" — 756 — 1–16
Leucotermes—
  flavipes. See Ants, white.
  licufugus. See Ants, white.
  virginicus. See Ants, white.
Libraries, damage to books by white ants — 759 — 8, 10
Licenses—
  fishing, requirements — 774 — 55
  hunting, legislation 1916 — 774 — 6–7
Lime carbonate, use in manufacture of muscadine-grape sirup — 758 — 7, 9–10
Live stock—
  diseases, dissemination by crow, note — 755 — 18
  farming, muck lands, Indiana and Michigan, crops, management, etc — 761 — 12–14
Long Island, game laws, 1916 — 774 — 28
Louisiana—
  game laws, 1916 — 774 — 8, 38, 45, 49, 58, 63
  game legislation, 1916 — 774 — 8
Lucern—
  sand, characteristics and value — 757 — 13–14
    See also Alfalfa.
Luginbill, Philip, and W. R. Walton, bulletin on "The fall army worm, or 'grassworm,' and its control" — 752 — 1–16

Machinery—
  cotton gin, description and discussion — 764 — 8–21
  dry-farming, requirements and descriptions — 769 — 6–13
  peanut-oil, requirements — 751 — 7
"Mahogany flat." *See* Bedbug.
Maine, game laws, 1916 — 774 — 25–26, 39, 45, 51, 54, 58, 63
Manitoba, game—
  laws, 1916 — 774 — 11–12, 34, 42, 47, 52, 62, 64
  legislation, 1916 — 774 — 11–12
Mariposa, bird, description, habits, and destruction of insects — 755 — 15–16
Market—
  gardens, damage by false chinch bug, Kansas and Colorado — 762 — 1
  potato, weighing practices and suggestions — 753 — 38–39
Marketing—
  cotton in the seed—
    by States, amounts and per cent of crops — 775 — 1
    losses from, bulletin by Charles F. Creswell — 775 — 1–8
  growers' cooperative organization, potato shipments, management and methods — 753 — 7–10
  potatoes—
    commercial, grading, handling, etc., bulletin by C. T. More and C. R. Dorland — 753 — 1–40
    cooperative associations, advantages — 753 — 22–23
    methods and practices — 753 — 29–39

	Farmers' Bulletin No.	Page.
MARLATT, C. L., bulletin on "The bedbug"	754	1–12
Marshland, drained, rye growing, advantages	756	8
Martin, purple, description, habits, and destruction of insects	755	28–29
Maryland, game—		
laws, 1916	774	8–9, 39, 45, 49, 51, 55, 58, 63
legislation, 1916	774	8–9
Massachusetts, game—		
laws, 1916	774	9, 39, 45, 49, 51, 54, 59, 63
legislation, 1916	774	9
Mating, geese, selection and management	767	9–10
May beetles, bird enemies, destruction by	775	3
MCATEE, W. L.—		
bulletin on "How to attract birds in Northwestern United States"	760	1–12
F. E. L. BEAL, and E. R. KALMBACH, bulletin on "Common birds of Southeastern United States in relation to agriculture"	755	1–40
Meadowlark—		
description, habits, and destruction of insects	755	19–21
destruction of chinch bug	755	4
Meal, peanut, nature and value	751	12
Meats, cooking by fireless cooker, directions	771	14–15
Medicago—		
falcata. *See* Alfalfa, yellow-flowered.		
sativa. *See* Alfalfa, common.		
Megaquiscalus major. *See* Grackle, boat-tailed.		
Michigan—		
game laws, 1916	774	26, 37, 45, 49, 51, 54, 55, 59, 63
southern, muck-land farms, management (and in northern Indiana), bulletin by H. R. Smalley	761	1–26
MILLIKEN, F. B., bulletin on "The false chinch bug and measures for controlling it"	762	1–4
Mills, peanut-oil, types and value	751	10–11
Mimus polyglottos, description, habits, and destruction of insects	755	9–11
Minnesota, game laws, 1916	774	26, 40, 45, 49, 51, 55, 59, 63
Mint farms, muck lands, Indiana and Michigan, acreage, labor associated crops	761	11–12
Mississippi—		
Game and Fish Department, constitutionality of act, litigation	774	9
game laws, 1916	774	9, 40, 45, 51, 59, 63
legislation, 1916	774	9
Valley, fall army worm, outbreaks, influence of weather conditions	752	6
Missouri, game laws, 1916	774	27, 40, 45, 49, 51, 59, 63
Mockingbird, description, habits, and destruction of insects	755	9–11
Moisture, soil, crop consumption and losses	773	8–9

	Farmers' Bulletin No.	Page.
Molting, canaries, time, symptoms, etc	770	11–12
Monarthrum—		
Mali, description, occurrence, and habits	763	13–14
spp. *See* pinhole borers.		
Montana, game laws, 1916	774	27, 40, 45, 51, 55, 59, 63
More, C. T. and C. R. Dorland, bulletin on "Commercial handling, grading, and marketing of potatoes"	753	1–40
Muck—		
farms, Indiana and Michigan, types, relation to income, investments, labor, and profits and income	761	14–21
land—		
crop rotation, practices and suggestions	761	26
crops, yield, per cent sold, and prices, 1914, and 10-year average	761	8
development and management	761	21–26
farming, types, conditions influencing	761	6–7
farms, management in northern Indiana and southern Michigan, bulletin by H. R. Smalley	761	1–26
Mule-foot hog—		
immunization to cholera, note	765	15
record associations, location and secretaries	765	15
Muscadine grape—		
occurrence	758	1
sirup—		
bulletin by Charles Dearing	758	1–11
See also Sirup, muscadine.		
Muscadine grapes—		
picking, crushing, and prepartion for sirup making	758	3–6
pressing for sirup making, operation	758	4–6
yield of juice and sirup	758	6
Muscadine sirup. *See also* Sirup.		
Muscadine sirups, tests	758	2–3
Muscivora forficata, description, habits, and destruction of insects	755	29–31
Nebraska—		
corn yield, dry and wet seasons, comparison	773	8
game laws, 1916	774	27, 40, 46, 51, 55, 59, 63
Nematode—		
root-knot, effect of sugar beet, comparison with effect of sugar-beet nematode	772	10
sugar-beet—		
control, bulletin by Harry B. Shaw	772	1–19
See also Eelworm, sugar-beet.		
Nesting—		
habits, birds in Southeastern United States	755	5, 7, 11, 13, 15–16, 20, 23, 24–25, 26, 28, 29, 33, 36, 38
places, birds, attraction to homestead	760	2–3
Nevada, game laws, 1916	774	27, 40, 46, 49, 51, 55, 59, 63

	Farmers' Bulletin No.	Page.
New Brunswick, game laws, 1916	774	34, 42, 47, 53, 54, 62, 64
New Hampshire, game laws, 1916	774	27, 40, 46, 49, 51, 54, 59, 63
New Jersey—		
game laws, 1916	774	9–10, 40, 46, 49, 51, 54, 56, 57, 59, 63
game legislation, 1916	774	9–10
New Mexico, game laws, 1916	774	28, 40, 46, 49, 52, 55, 59, 63
New York—		
game laws, 1916	774	10, 28, 40, 46, 49, 52, 56, 60, 63
game legislation, 1916	774	10
Newfoundland, game laws, 1916	774	34, 42, 47, 53, 56, 62, 64
Nighthawk—		
description, habits, and destruction of insects	755	33–34
use against May beetle	755	3
Nonpareil bird, description, habits, and destruction of insects	755	15–16
North Carolina, game laws, 1916	774	29, 40, 46, 49, 52, 56, 60, 63
North Dakota—		
corn, yield, dry and wet seasons, comparison	773	8
game laws, 1916	774	29, 40, 46, 49, 60, 63
Northwest Territory, game laws, 1916	774	36
Nova Scotia—		
game laws, 1916	774	12, 34, 42, 47, 52–56, 62, 64
game legislation, 1916	774	12
Nursery stock—		
damage by white ants	759	11
protection from white ant	759	18
Nysius cricae. See Chinch bug, false.		
Oakley, R. A., and H. L. Westover, bulletin on "Commercial varieties of alfalfa"	757	1–24
Oatmeal, cooking by fireless cooker, directions	771	11–12
Oats—		
growing on dry lands, Idaho, varieties and methods	769	21–22
growing on muck land, labor value by acre and by day	761	6
Ohio, game laws, 1916	774	29, 40, 46, 52, 54, 56, 60, 63

	Farmers' Bulletin No.	Page.
Oil, peanut—		
bulletin by H. G. Thompson and H. S. Bailey	751	1–16
comparison with cottonseed oil	751	11–12
economic importance	751	2
grades and uses	751	3–4, 11–12
manufacture—		
in Europe	751	2–4
in United States, economic considerations	751	10–13
in United States, status and outlook	751	10–12
processes	751	3–4
production in Marseille, 1912	751	2
Oils, mint, uses, cooperative distillation, and by-products	761	11–12
Oklahoma—		
cotton marketing, investigations	775	1. 5
game laws, 1916	774	29, 40, 46, 49, 52. 54, 56, 60, 63
Onion—		
farming, muck lands, Indiana and Michigan, area, labor, associated crops, etc	761	9–11
wild, pest of rye fields	756	14–15
Onions, growing on muck land, labor value by acre and by day	761	6
Ontario—		
game laws, 1916	774	12, 35, 42, 48, 52, 54. 55, 62, 64
game legislation, 1916	774	12
Orchard barkbeetles and pinhole borers and how to control them, bulletin by Fred E. Brooks	763	1–16
Oregon, game laws, 1916	774	29–30, 40, 46, 49, 52, 54, 55, 60, 63
Orenberg alfalfa, note	757	19–20
Oriole, use in destruction of boll weevil	755	3
"Overflow worm." *See* Army worm, fall.		
Painted bunting, description, habits, and destruction of insects	755	15–16
PALMER, T. S., W. F. BANCROFT, and FRANK L. EARNSHAW, bulletin on "Game laws for 1916: A summary of the provisions relating to seasons, export, sale, limits, and licenses"	774	1–64
Paris green, use against cutworms	773	21
Parrot bill, description, habits, and destruction of insects	755	14–15
Partridge, description, habits, and destruction of insects	755	36–37
Passerina ciris, description, habits, and destruction of insects	755	15–16
Pasture crop, rye, advantages	756	8
Pasturing, corn, practices and advantages	773	23
Peach-tree barkbeetle—		
brood chamber, description	763	8–9
control measures	763	9–13
description, occurrence, and life history	763	6–9
Peanut—		
hulls, utilization	751	12
oil, bulletin by H. C. Thompson and H. S. Bailey	751	1–16
products, labeling, suggestions	751	15
Peanut oil—		
cake, composition	751	3
industry, importance	751	1–2
manufacture, by-products	751	12
See also Oil, peanut.		

	Farmers' Bulletin No.	Page.
Peanuts—		
American, analyses	751	7–9
hulling, methods	751	2–3
imports by Germany, 1912	751	2
Marseille market, sources, quantity, imported, etc	751	2
oil yields of varieties on Marseille market	751	2
preparation for oil making	751	6–7
production—		
increase, relation to peanut-oil industry, outlook	751	1–2
yield, cost, and returns	751	13–15
varieties in United States, descriptions, and analyses	751	4–5, 7–9
yield of oil, amount crushed at Marseille, 1912, etc	751	2
Pear-blight beetle, description, occurrence, habits, and remedies	763	14–15
Pennsylvania game laws, 1916	774	30, 40, 46, 49, 52, 54, 56, 57, 60, 63
Penthestes carolinensis, description, habits, and destruction of insects	755	24–26
Pepper, sweet, use as food for canaries for color	770	13
Peppermint growing—		
muck lands, Indiana and Michigan, area, labor, associated crops, etc	761	11–12
on muck land, labor, value by acre and by day	761	6
Pest, bedbug, bulletin by C. L. Marlatt	754	1–12
Pests, "white ants," and methods for preventing damage, bulletin by T. E. Snyder	759	1–20
Petroleum shield, use against false chinch bug, construction, and value	762	3–4
Pettit, R. H., formula for extermination of bedbugs	754	12
Pinhole—		
borer, description, and injury to fruit trees	763	3
borers, orchard, and barkbeetles, and how to control them, bulletin by Fred E. Brooks	763	1–16
Planting, corn, dry lands, methods, and suggestions	773	14–16
Plowing, dry-land, for corn growing	773	10–12
Plows, dry-land, requirements, and descriptions	769	7–8
Poison baits, enemies of growing corn, use, and preparation	773	20–21
Poison, bran—		
bait, use against fall army worm	752	14
mash, use against cabbage worms	766	11–12
Poisons, use against cabbage worms	766	11–12
Poland-China hog—		
origin, fecundity, and quality of pork	765	5–6
record, associations, location, and secretaries	765	6
types, descriptions, and market demands	765	5–6
Pontia rapæ. *See* Cabbage worm.		
Pop, bird, description, habits, and destruction of insects	755	15–16
Pot roast, cooking by fireless cooker, directions	771	14
Potatoes—		
commercial handling, grading, and marketing, bulletin by C. T. More and C. R. Dorland	753	1–40
defective, marketing, economic considerations	753	15–18
early crop, handling methods in South	753	2–10
graded, market demands	753	3–4
grades, recommendations	753	20–22
growing on muck land, labor value by acre and by day	761	6
new, handling for market	753	27–29
picking methods	753	11–12
shrinkage	753	37–38
standardization, need, and demand, discussion	753	18–22
Poultry, insect pest in southwestern United States and Mexico	754	3
Prairie dogs, poison bait, preparation and use	773	21
PRESIDENT, proclamation for protection of migratory birds	774	13–17
Press, grape, homemade, construction	758	4–6

	Farmers' Bulletin No.	Page.
Prices, seed-cotton, comparison with lint-cotton prices	775	4–8
Prince Edward Island, game laws, 1916	774	35, 42, 53, 55, 56, 62, 64
Progne subis, description, habits and destruction of insects	755	28–29
Provence alfalfa, source, comparison with domestic strains	757	6–7
Publications—		
bird food, list	755	40
birds, list	760	12
Department, relating to cotton	764	28
insects injurious to deciduous fruits, list	763	16
Puddings, cooking by fireless cooker	771	16
Pyrethrum, use against—		
cabbage worm	766	12
canary parasites	770	17
Pyrrhuloxia sinuata texana, description, habits and destruction of insects	755	14–15
Quail, Bob-white, description, habits and destruction of insects	755	36–37
Quebec, game—		
laws, 1916	774	12, 35, 42, 48, 52, 62, 64
legislation, 1916	774	12
Rain crow, description, habits and destruction of insects	755	34–36
Rape butterfly, description and life history	766	1–3
Recipes, fireless cooking	771	11–16
"Red coat." *See* Bedbug.		
Redbird, description, habits, and destruction of insects	755	13–14
Rhode Island—		
game laws, 1916	774	10, 30, 41, 47, 52, 54, 56, 60, 63
game legislation, 1916	774	10
Rice—		
destruction by boat-tailed grackle	755	22
in palif, recipe for fireless cooking	771	12
Roasts, cooking by fireless cooker	771	14–15
Robin, use against wireworms	755	3
Rollers, use on dry lands of Idaho	769	9–10
Rose, potato, No. 4, production in Florida, handling, grading and marketing	753	2–5
Rotation, crop, place of rye	756	6–8
ROTHGEB, BENTON E., bulletin on "Dwarf broom corns"	768	1–16
Russian knapweed, occurrence in Turkestan alfalfa seed	757	8
Rye—		
acreage, 1909, by States	756	2
culture, eastern United States, bulletin by Clyde E. Leighty	756	1–16
diseases and enemies	756	15–16
ergot infected, feeding to live stock, caution	756	16
growing—		
advantages, comparison with wheat	756	7–8
in cotton belt, varieties, yield, etc	756	3–4
on dry lands, Idaho, note	769	23
on muck land, labor value by acre and by day	761	6
pests	756	14–16
seed, vitality, and testing	756	11
soil, place in rotation and cultural directions	756	5–13
soils suitable	756	5
spring, objections	756	3
thrashing, practices and suggestions	756	14

	Farmers' Bulletin No.	Page.
Rye—Continued.		
treatment of seed for ergot	756	16
varieties, value, and tests	756	4–5
vitality of seed, testing	756	11
Sand lucern, characteristics and value	757	13–14
Sandy mocker, description, habits, and destruction of insects	755	11–13
Sardines, cooking in peanut oil, practices at canneries	751	4
Saskatchewan, game—		
laws, 1916	774	12, 36, 43, 48, 52, 54, 62, 64
legislation, 1916	774	12
Scotlius rugulosus. *See* Fruit-tree barkbeetle.		
Seed—		
alfalfa. *See* alfalfa seed.		
bed, preparation for dry-land grain crops	769	14–16
broom corn, sources and selection, caution	768	5
corn—		
selection for semiarid regions	773	21
sources, importance	773	22–23
wheat, selection, grading, and treatment, dry-land farming	769	13–14
Seed-cotton—		
losses from marketing, bulletin by Charles F. Cresswell	775	1–8
marketing, amounts and percentage of crops, by States	775	1
prices—		
comparison with ginned cotton	775	4–8
determination, difficulties	775	3–4
Seeding, rye, time and methods	756	11–13
Semipalatinsk alfalfa, note	757	19–20
Serin finch, range, description, and habits	770	4–5
Serinus serinus—		
canarius. *See* Canary.		
serinus. *See* Serin finch.		
SHAW, HARRY B., bulletin on "Control of sugar-beet nematode"	772	1–19
Shipping, potatoes—		
containers, brands, etc., requirements	753	23–26
railroad billing	753	36–37
Shot-hole borer. *See* Fruit-tree barkbeetle.		
Sialia sialis, description, habits, and destruction of insects	755	23–24
Sirup, muscadine grape—		
bulletin by Charles Dearing	758	1–11
making, processes	758	7–9
manufacture, equipment, etc	758	2–11
Skunk, enemy of fall army worm	752	12
"Slicker," construction and value in dry-land farming	769	9
SMALLEY, H. R., bulletin on "Management of muck-land farms in northern Indiana and in southern Michigan"	761	1–26
Smut, stinking, control treatment of seed wheat	769	14
Smuts, broom corn, descriptions and treatment	768	14
Snake River basin, extent, topography, climate, and soils	769	4–6
SNYDER, T. E., bulletin on "'White ants' as pests in the United States and methods of preventing their damage"	759	1–20
Soap emulsion, use against false chinch bug, preparation and value	762	2–3
Soil—		
dry-land, treatment for moisture storage	773	9
moisture conservation, treatment	773	8–11
muck, nature and management	761	23–26
Soils, nature, relation to moisture conservation	773	8–11
Soldier bug, spined, description, enemy of fall army worm	752	11–12
Song birds, Southeastern United States	755	7, 9, 11, 13, 14, 15

	Farmers' Bulletin No.	Page.
Soups—		
preparation and ingredients with fireless cooking	771	13–14
recipes for fireless cooking	771	12–14
South Carolina—		
game—		
laws, 1916	774	10, 30, 41, 47, 52, 55, 56, 60, 63
legislation, 1916	774	10
potatoes, early crop, handling methods	753	5
South Dakota—		
corn yield, dry and wet seasons, comparison	773	8
game laws, 1916	774	30, 40, 46, 49, 52, 55, 60, 63
South, damage to crops by fall army worm, 1912, note	752	4–5
" Southern—		
army worm." *See* Army worm, fall.		
potatoes, marketing, methods and practices	753	30–31
Sowing, broom-corn seed, rate, time and method	768	7–8
Sows, fecundity of standard breeds	765	6, 7, 9, 10, 12, 13
Spanish—		
alfalfa seed, receipts, suggestions to growers	757	7
peanut—		
description, value, and composition	751	5, 8–9
oil yield	751	12
Spiders, destruction by birds	755	8, 21, 26, 27
Spraying, fall army-worn control	752	13–14
Sprays, fall army-worm control	752	5
Stock. *See* Live stock.		
Storage, broom corn	768	13
Stored products—		
injury by white ants	759	8
protection from white ants	759	17–18
Stover, broom corn, uses and value	768	15–16
Straw, rye, advantages over other straw	756	8
Strychnine, use against rodents	773	21
Sturnella magna, description, habits and destruction of insects	755	19–21
Sugar-beet nematode, control, bulletin by Harry B. Shaw	772	1–19
Sulphur fumes, use against bedbugs	754	11
Swallow, purple martin, description, habits and destruction of insects	755	28–29
Swallows, use in destruction of boll weevil	755	3
Swamp land—		
farming, management in Indiana and Michigan	761	3–26
Indiana and Michigan, acreage and improvement	761	1–2
Swarming, white ants, habits	759	4–5
Swine—		
breeds, bulletin by F. G. Ashbrook	765	1–16
See also Hogs.		
Tamworth hog—		
origin, description, and quality of pork	765	12–13
record association, location and secretary	765	13
TAYLOR, FRED, D. C. GRIFFITH, and F. E. ATKINSON, bulletin on " Cotton ginning information for farmers "	764	1–28
Tennessee, game laws, 1916	774	31, 40, 46, 52, 60, 63

	Farmers' Bulletin No.	Page.
Termites. *See* Ants, white.		
Texas, game laws, 1916	774	31, 40, 46, 52, 60, 63
THOMPSON, H. C., and H. S. BAILEY, bulletin on "Peanut oil"	751	1–16
Thrasher, brown, description, habits, and destruction of insects	755	11–13
Thrashing—		
broom corn, methods	768	9–10
rye, practices and suggestions	756	14
Threadworm, sugar-beet eelworm, control	772	1–19
Thryothorus ludovicianus, description, habits, and destruction of insects	755	7–9
Timbers—		
damage by white ants	759	5–8
treatment against white ants	759	16–17
Titmouse, tufted, description, habits, and destruction of insects	755	26–28
Toad, enemy of fall army worm, note	752	13
Toulouse goose, description and value	767	4
Toxostoma rufum, description, habits, and destruction of insects	755	11–13
Treaties, supremacy to State laws, note	774	18
Treaty, United States with Great Britain, for protection of migratory birds	774	18–20
Trees, protection from white ants	759	18
Troglodytes aedon, description, habits, and destruction of insects	755	5–7
Truck—		
crops, insects injurious, publications of Department	766	15–16
farming, muck lands, Indiana and Michigan	761	3–26
insects, bird enemies	755	5
Turkestan alfalfas, comparison with American-grown strains	757	7–8
Turkey buzzard, description, habits, and economic value	755	37–39
Utah, game laws, 1916	774	31, 40, 46, 49, 52, 55, 60, 63
"Variegated" alfalfa group, characteristics of different strains	757	8–14
Vegetable soup, recipe for fireless cooking	771	12
Vegetables, fresh and dried, cooking by fireless cooker	771	15–16
Vermont, game laws, 1916	774	31, 40, 46, 49, 52, 54–56, 60, 69
Victoria hog, origin and value of pork	765	16
Vineyards, damage by white ants	759	12
Virginia—		
game laws, 1916	774	10–11, 31–32, 41, 47, 52, 61, 64
game legislation, 1916	774	10–11
potato crop, handling, harvesting, and marketing	753	5–10
Vulture, black, description, habits, and economic value	755	38
"Wall-louse." *See* Bedbug.		
WALTON, W. R., and PHILIP LUGINBILL, bulletin on "The fall army worm, or 'grass worm,' and its control"	752	1–16
Washington, game laws, 1916	774	32, 41, 47, 52, 55, 61, 64
Weeders, dry-land, descriptions	769	9
West Virginia, game laws, 1916	774	32–33, 41, 47, 52, 54, 55, 56, 61, 64

	Farmers' Bulletin No.	Page.
WESTOVER, H. L., and R. A. OAKLEY, bulletin on "Commercial varieties of alfalfa"	757	1–24
WETMORE, ALEXANDER, bulletin on "Canaries: Their care and management"	770	1–20
Wheat—		
growing on—		
muck land, labor value by acre and by day	761	6
southern Idaho dry farms, varieties and methods	769	16–21
seed—		
selection, grading, and treatment, dry-land farming	769	13–14
treatment for bunt	769	14
"Whiskered beets," cause and appearance	772	8
"White ants"—		
pests in United States and methods of preventing damage, bulletin by T. E. Snyder	759	1–20
See also Ants, white.		
Whitewash, use against orchard barkbeetles	763	12–13
Wild goose, description and value	767	6
Winthemia quadripustulata, description, enemy of fall army worm	752	10–11
Wireworms, destruction by bird enemies	755	3
Wisconsin, game laws, 1916	774	33, 41, 47, 53–55, 61, 64
Woodpecker, red-cockaded, description, habits, and destruction of insects	775	31–32
Wood-stainer, apple, description, occurrence, and habits	763	13–14
"Work—		
unit," use of term	761	17
unit, variation with type of farm	761	17
Worm, fall army, and its control, bulletin by W. H. Walton and Philip Luginbill	752	1–16
Worms, control methods	766	10–13
Wrens, descriptions, habits, and destruction of insects	755	5–9
Wyoming, game laws, 1916	774	33, 42, 47, 53–55, 61, 64
Yorkshire hog—		
description, record association, and address of secretary	765	15–16
origin, description, and value	765	13–14
Yukon, game laws, 1916	774	36, 43, 48, 53, 62, 64
Zinc arsenite, use against fall army worm	752	5
ZOOK, L. L., and C. P. HARTLEY, bulletin on "Corn growing under droughty conditions"	773	1–24

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